United States Army Aviation Logistics School
Fort Eustis, Virginia

APRIL, 1994

THIS DOCUMENT HAS BEEN REVIEWED FOR OPSEC CONSIDERATIONS

STUDENT HANDOUT

DESIGN CONSIDERATIONS/AIRFRAME

071-620-04

The proponent for this SH is USAALS

TERMINAL LEARNING OBJECTIVE:

At the completion of this lesson you will:

ACTION: Analyze the airworthiness of the airframe; to include maintainability, survivability, weight and balance factors, computation procedures, and deployment considerations.

CONDITIONS: Given the Student Handout.

STANDARDS: Determine orally, in writing, and/or by selecting from a list, the design factors incorporated into the AH-64A in accordance with the applicable technical manuals.

SAFETY REQUIREMENTS: In addition to the specific safety requirements of this lesson plan, aviation shop and flight line safety standards established in the applicable manuals will be reinforced.

RISK ASSESSMENT LEVEL: Low

ENVIRONMENTAL CONSIDERATIONS: None

EVALUATION: This lesson will be evaluated during 9C7-510-04, Practical Written Exam.

A. Design Goals

1. Operational concepts

a. The AH-64A (Apache) is designed to provide direct aerial fire in support of ground combat forces in day, night, and marginal weather conditions.

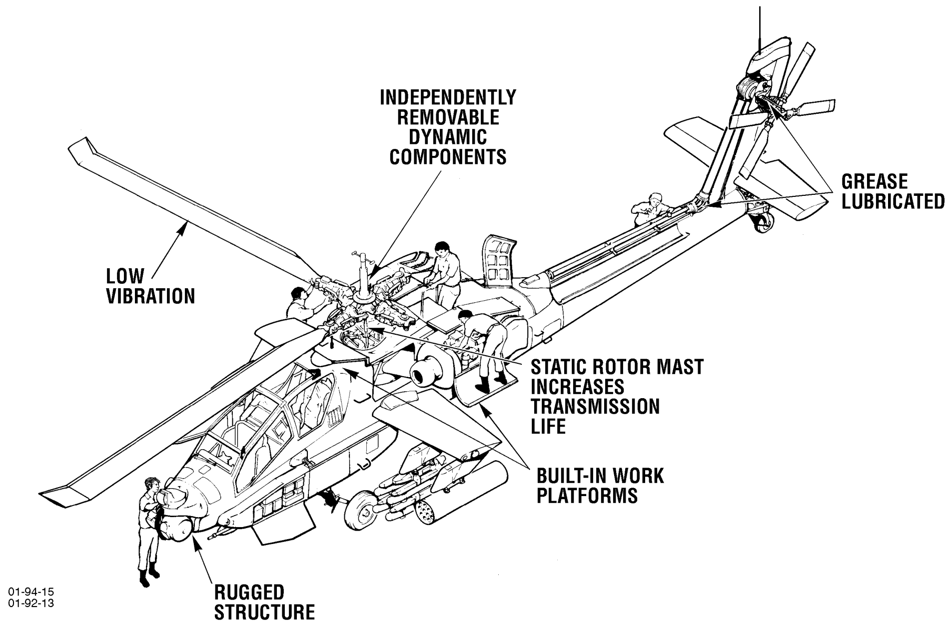
b. It is to be employed in battalion, company, platoon, and section sized units, rather than as individual helicopters, and is controlled by the lowest level tactical ground commander capable of directing and integrating the helicopters into tactical plans.

c. The Apache is designed to operate at temperature ranges between -25EF (-31.7EC) and +125EF (+51.7EC), including climatic conditions of moderate turbulence and icing without the addition of special equipment kits. With kits, this capability is expanded to temperatures between -65EF (-53.9EC) and +125EF (+51.7EC). Fuel for operations is JP4, JP5, and JP8, except JP5 should not be used at temperatures below -25EF (-31.7EC). Below -25EF (-31.7EC), lubrication fluid will be changed to MIL-L-7808. MIL-L-23699 and MIL-L-83832 are authorized for use above -25EF (-31.7EC).

d. The helicopter has the capability to fly to and from operational areas in rotary wing instrument meteorological conditions, and has a ferry range (with extended range fuel kits) of 1000 nautical miles with a 10 percent fuel reserve.

e. The AH-64A's primary mission is anti-armor, and is flexible enough to be configured for other missions as well as self-deployment.

AH-64A MAINTAINABILITY



NOTES

2. Maintainability

   a. The design specifications required for ease of maintenance were built into the aircraft.

   b. Automatic fault detection and location is built in where possible. Modular maintenance is maximized to reduce required down time.

   c. Support equipment is minimized where possible. Design of new "suitcase" test equipment to support AH-64A systems was prohibited.

   d. Quick disconnects are used for electrical connectors, hydraulic fluid, fuel, and pneumatic line couplings and are subject to time replacement or minimum service life criteria.

   e. Positive locking plumbing connectors are provided for critical safety-of-flight items such as fuel and oil lines.

   f. Hydraulic fluid quick disconnects are not provided for transmission-mounted and driven accessories.

   g. Critical items are designed to preclude incorrect installation. Line replaceable units (LRUs) and modules are utilized to the maximum extent possible.

   h. The requirement for lockwire safetying is minimized by the use of captive hardware and self-locking devices.

   i. Mechanic requirements

      (1) School trained, six months experience on the job.

      (2) No more than two (2) required for any AVUM task except boresighting or removal and replacement of major dynamic or fire control components.

3. Accessibility

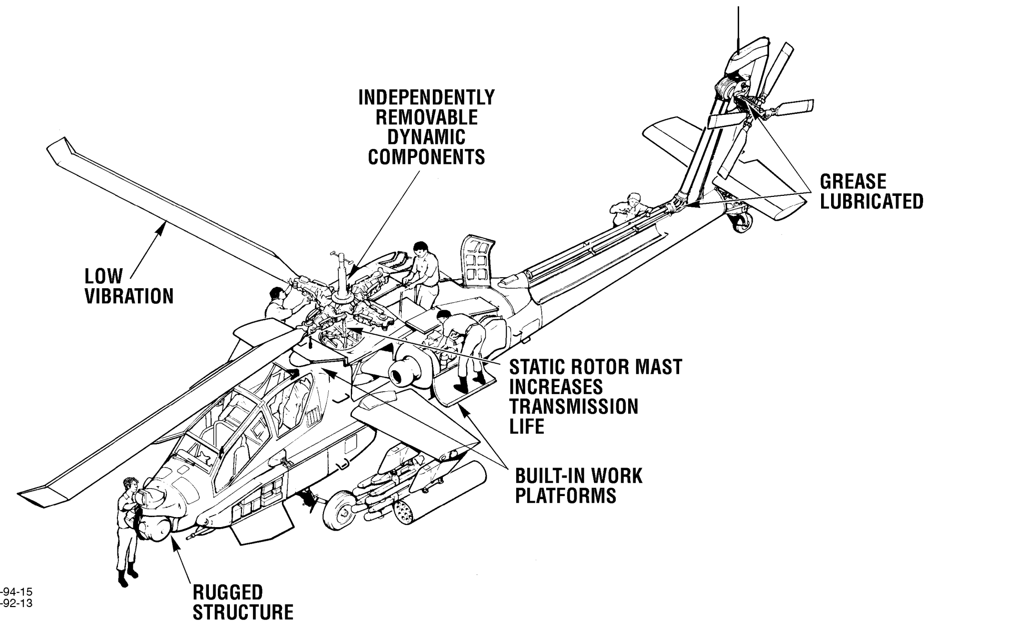
   a. Each access panel is to be labeled for easy identification and correlation with the technical manuals.

      (1) Panels are numbered in relation to the nearest fuselage station number in the center of the panel.

      (2) A leading prefix indicates whether it is a left side, right side, top, bottom, wing, nacelle, pylon, or other access panel.

   b. During design, prime consideration was given to inspection requirements. Access to components requiring adjustment, rigging, testing, or checking is as simple as practicable.

AH-64A MAINTAINABILITY



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c. Removal of components or modules to access other components is minimized. Critical items are positioned or supported to prevent damage during servicing and maintenance.

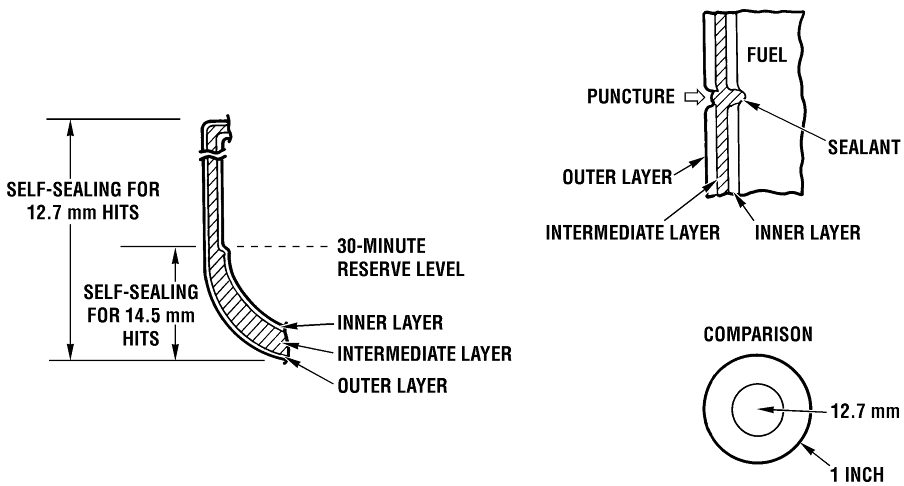
d. Handholds, steps, and platforms are strategically located to facilitate maintenance personnel ingress and egress. Use of special stands to view fuel, oil, and lubricant servicing levels was prohibited as a design concept.

4. Turnaround time

a. Refuel - not to exceed 10 minutes, including performing necessary operational and maintenance checks.

b. Rearm - not to exceed 10 minutes to replenish the primary mission configuration of 8 Hellfire missiles and 320 rounds of ammunition.

SELF-SEALING CAPABILITY



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5. Survivability

a. The aircraft design considered operation after ballistic damage. It had to be capable of sustaining up to (a single) 23mm high explosive impact without catastrophic failure.

b. Self-sealing fuel system

(1) Fuel cells and fuel lines are self sealing for up to 12.7mm projectiles.

(2) 30-minute fuel reserve levels are self sealing for up to 14.5mm projectiles.

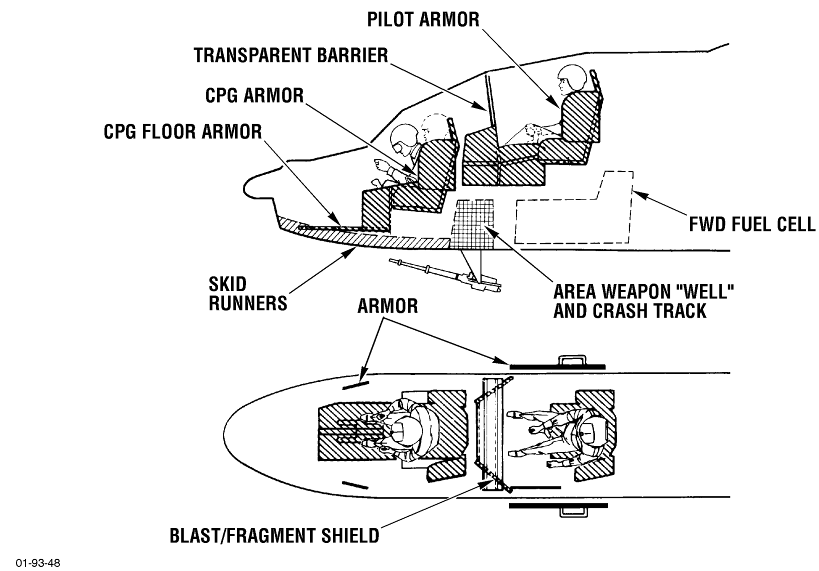
(3) Fuel cell walls are comprised of three layers.

(a) Outer and inner layers are synthetic rubber and nylon.

(b) Intermediate layer (sealant) is natural rubber.

(c) If a projectile penetrates the three layers, it pulls the sealant into the fuel cell. Sealant contact with fuel causes the sealant to swell, plugging the hole.

AIRCREW PROTECTION



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c. Integral and parasitic armor

(1) Extensive use of Kevlar and boron carbide for airframe and aircrew protection.

(a) Kevlar is a synthetic, resin-base fiber that is stronger than fiberglass.

(b) Boron carbide is compressed carbon that is extremely hard for its weight.

(2) Pilot and copilot seats are Kevlar/boron carbide armor.

(3) Copilot crew station floor is also armored. The pilot crewstation does not have floor armor because the forward fuel cell and associated airframe provides equal or greater penetration protection.

(4) Both crewstations have side armor mounted inside the cockpit. The pilot crewstation also has externally mounted (parasitic) armor.

(5) Blast/fragment shield

(a) Prevents both crewmembers from being incapacitated from a single 23mm high explosive incendiary hit.

(b) Acts as a roll bar, and helps deflect the main rotor blade.

(c) Lower section made of Kevlar and boron carbide.

(d) Upper section made of approximately 1.1 inches of clear stretched acrylic.

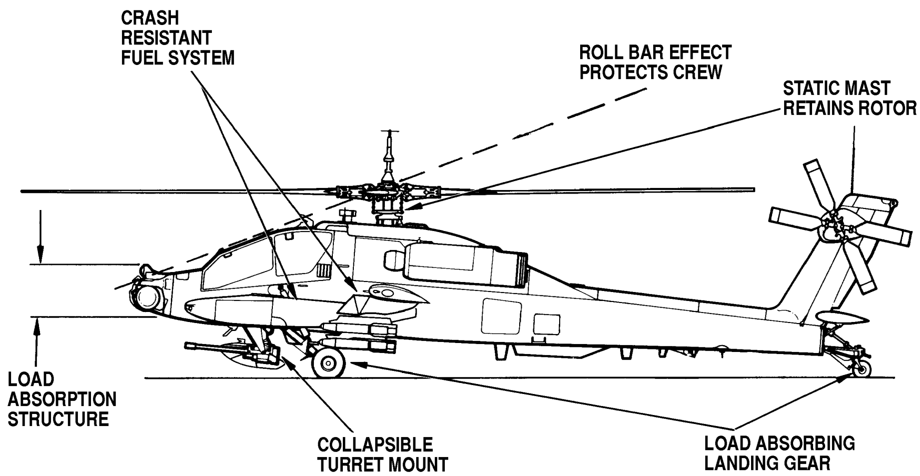
d. Critical components are made of high stress 4340 electroslag remelt (ESR) steel. Two of these are the main rotor pitch links and hydraulic actuator housings.

e. Failure of an engine or loss of transmission lubrication does not cause immediate downing of the aircraft. The main transmission is designed to operate for at least 30 minutes after loss of lubricating fluid.

f. System redundancy and backups - at least two failures within a system must occur before a critical situation exists.

g. All critical functions are available in a degraded mode of operation until a third failure occurs.

HIGH IMPACT SURVIVABILITY



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h. The aircraft protects the crew from injury in the event of a high velocity impact (vertical or lateral).

(1) Designed to endure 2520 feet per minute vertical impact (42 feet per second), at worst case, and maintain at least 85% of crewstation occupiable space.

(2) Two aluminum, longitudinal skid-runners resist forward fuselage deformation during high impact landings.

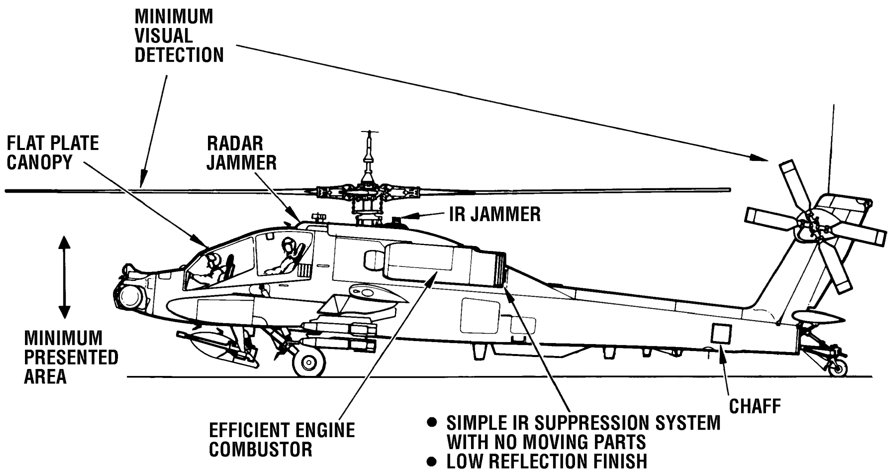
(3) Area weapon "well" and crash track prevents the weapon from rupturing the forward fuel cell.

(4) Canopy provides rollover and blade strike protection.

(5) Static mast retains rotor system from entering the pilot crewstation and provides a roll bar effect that protects the crew in case of rollover.

(6) Crash-resistant fuel system - breakaway valves at the connections to the fuel cells automatically seal if they are damaged during impact.

DETECTABILITY



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6. Reduced detectability

a. Low aural threshold - minimal external noise levels for hover and approach conditions.

b. Low visual detectability

(1) Flat plate canopy reduces specular reflections (glint) from the sun.

(2) Low reflection external finish results in low

(a) Specular reflection.

(b) Brightness contrast.

(c) Color contrast.

c. Engines

(1) Efficient engine combustion precludes hot particles or smoke being exhausted. The clean (smokeless) exhaust is not visible at any angle, day or night.

(2) Hot metal shielding for infrared (IR) suppression that precludes seeing hot metal that could otherwise be observed during darkness.

d. Reduced radar cross section to reduce the radar target image.

e. Active and passive aircraft survivability equipment (ASE)

(1) Radar warning and jamming

(a) Radar warning system - AN/APR-39, detects enemy radar threats.

(b) Provides audio warning signals through the intercommunications systems (ICS).

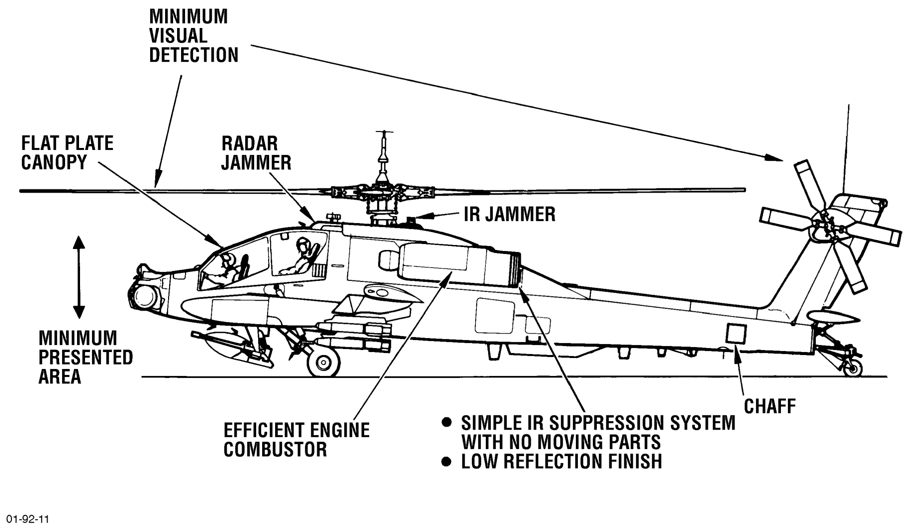
(c) Visual signals on the Radar Warning Indicator.

(d) Radar warning antennas - four directional (quadrant) antennas, one located in each forward avionics bay (FAB), and one located on each side of the vertical stabilizer.

(e) One omnidirectional (blade type) antenna located under the tail boom, just aft of the UHF/Lower identification-friend of foe (IFF) antenna.

(f) Radar jamming is automatic if the AN/ALQ-136 is operating.

DETECTABILITY



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(2) AN/ALQ-144 IR jammer provides active automatic countermeasures capability against IR seeking missiles.

(3) Chaff. M130 Chaff Dispensing kit provides countermeasures to decoy radar guided weapons away from the aircraft.

7. Selected design specifications

a. Service life

(1) Total service life of the helicopter is designed to be at least 15 years.

(2) Major airframe overhaul is not required with less than 4500 flight hours.

(3) Catastrophic failure rates will not exceed one failure per 20,800 flight hours. Catastrophic failure is defined as any in-flight failure, resulting in an injury that prevents a crewmember from performing mission functions, or any failure that does not permit a controlled landing.

b. Mean time between removal (MTBR)

(1) MTBR of major dynamic components is not less than 1500 flight hours.

(2) No major overhaul of dynamic components will be required at less than 4500 hours.

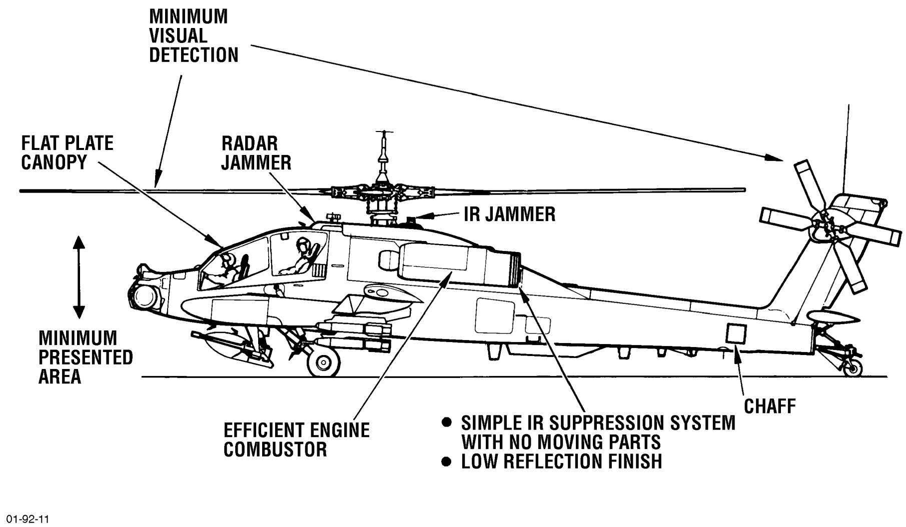
(3) The fatigue life of dynamic components is at least 4500 hours. Fatigue failure in these components is defined as any crack caused by repeated loads which is detectable by state-of-the-art non-destructive inspection techniques.

(4) For non-dynamic components, a fatigue failure is defined as a crack which renders the component inoperable, unable to support design load limits without failure.

c. Reliability aspects

(1) System reliability (based on one hour mission time) is defined as the probability that AH-64A systems (except for expendable ordinance and GSE) will incur no failures, including fault degradation, requiring unscheduled maintenance.

DETECTABILITY



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(2) Assuming mission start begins with preflight, and mission completion is the successful landing of the aircraft at a predetermined point, system reliability and the probability of completing that mission without occurrence of a malfunction or failure of applicable equipment is designed to be not less than 95 percent.

(3) Any failures detected during preflight that require less than 15 minutes to correct are not considered mission failure.

(4) An availability rate of 75% (required) is based on a utilization rate of 110 hours per month and a AVUM/AVIM maintenance man-hours factor of 9.0 hours per flight hour.

(5) The mean time to repair the aircraft or it's systems is 0.9 hours (assuming the mechanic is a maintenance school graduate with 6 months on-the-job experience).

(6) Definitions per AR 700-138.

(a) Fully mission capable (FMC)

(b) Partly mission capable (PMC)

(c) Not mission capable (NMC)

8. Developmental milestones

a. Feb 1972 Paper competition for the AAH between Hughes, Boeing/Vertol, Sikorsky, Bell, and Lockheed.

b. Jun 1973 Phase 1 competition prototype development contracts awarded to Bell Helicopters, Textron Inc., (model 409, YAH-63) and to Hughes Helicopters Inc., (model 77, YAH-64).

c. Jul 1973 T-700 engine contract awarded.

d. Oct 1974 First engine delivery.

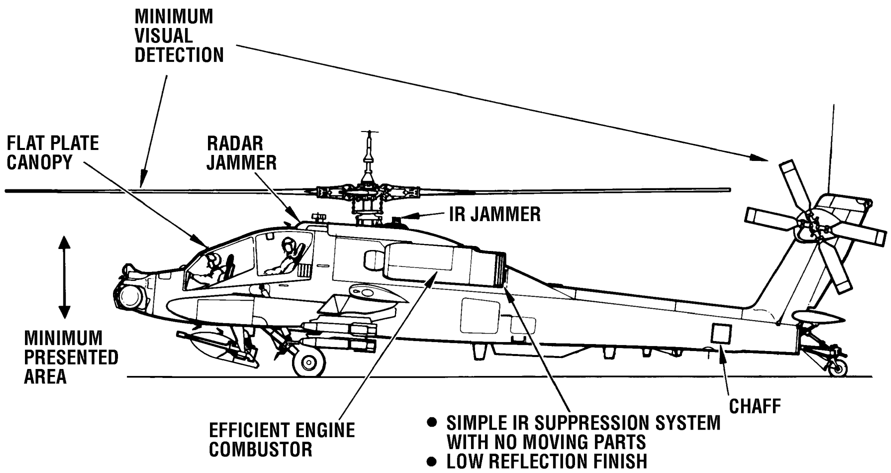
e. Sep 1975 First YAH-64 flight made by AV02 (air vehicle # 2).

f. Sep 1975 First YAH-63 flight.

g. Dec 1975 Competitive flyoffs begin.

h. Mar 1976 First in-flight firing of Hughes Helicopters-developed XM230E1 Chain Gun automatic cannon, and 2.75-inch folding fin aerial rockets.

DETECTABILITY



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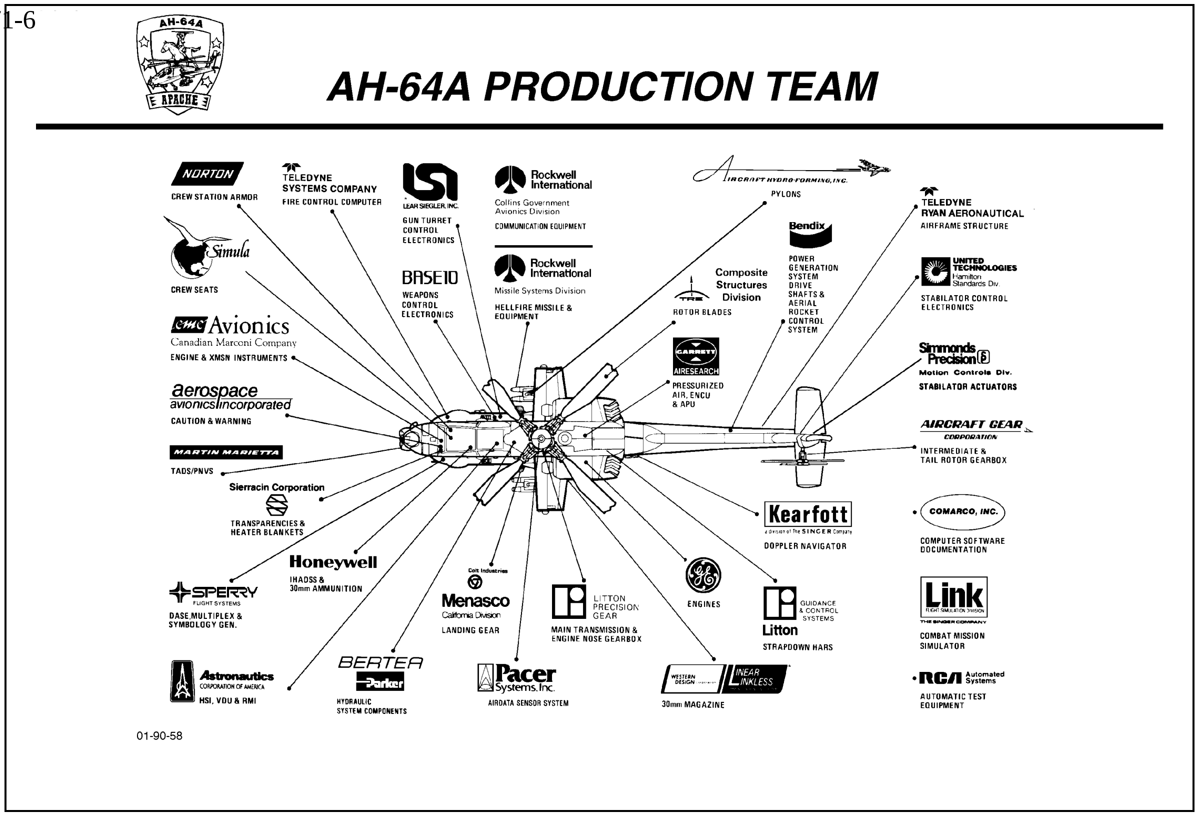
NOTES

i. Jun 1976 AV02 and AV03 begin government competitive testing program at the Army Engineering Flight Activity (AEFA).

j. Dec 1976 U.S. Army selects Hughes Helicopter's YAH-64 for Phase 2 development over Bell Helicopter's YAH-63. Phase 2 program is a 56-month full-scale engineering development for the YAH-64 (10 Dec).


AH-64A
APACHE
AH-64A PRODUCTION TEAM
NORTON
CREW STATION ARMOR
TELEDYNE
SYSTEMS COMPANY
FIRE CONTROL COMPUTER
LEAR SIEGLER, INC.
GUN TURRET
CONTROL
ELECTRONICS
Rockwell
International
Collins Government
Avionics Division
COMMUNICATION EQUIPMENT
Simula
CREW SEATS
BASE10
WEAPONS
CONTROL
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Missile Systems Division
HELLFIRE MISSILE &
EQUIPMENT
cmc Avionics
Canadian Marconi Company
ENGINE & XMSN INSTRUMENTS
aerospace
avionics incorporated
CAUTION & WARNING
MARTIN MARIETTA
TADS/PNVS
Sierracin Corporation
TRANSPARENCIES &
HEATER BLANKETS
AIRCRAFT HYDRO-FORMING, INC.
PYLONS
TELEDYNE
RYAN AERONAUTICAL
AIRFRAME STRUCTURE
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SHAFTS &
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TRE
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UNITED
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Hamilton
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AIRESEARCH
PRESSURIZED
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& APU
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Kearfott
a division of The SINGER Company
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COMARCO, INC.
COMPUTER SOFTWARE
DOCUMENTATION
SPERRY
FLIGHT SYSTEMS
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Honeywell
IHADSS &
30mm AMMUNITION
Colt Industries
Menasco
California Division
LANDING GEAR
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PRECISION
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MAIN TRANSMISSION &
ENGINE NOSE GEARBOX
ENGINES
GUIDANCE
& CONTROL
SYSTEMS
Litton
STRAPDOWN HARS
Link
FLIGHT SIMULATION DIVISION
THE SINGER COMPANY
COMBAT MISSION
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Astronautics
CORPORATION OF AMERICA
HSI, VDU & RMI
BERTEA
Parker
HYDRAULIC
SYSTEM COMPONENTS
Pacer
Systems, Inc.
AIRDATA SENSOR SYSTEM
WESTERN
DESIGN
LINEAR
LINKLESS
30mm MAGAZINE
RCA Automated
Systems
AUTOMATIC TEST
EQUIPMENT
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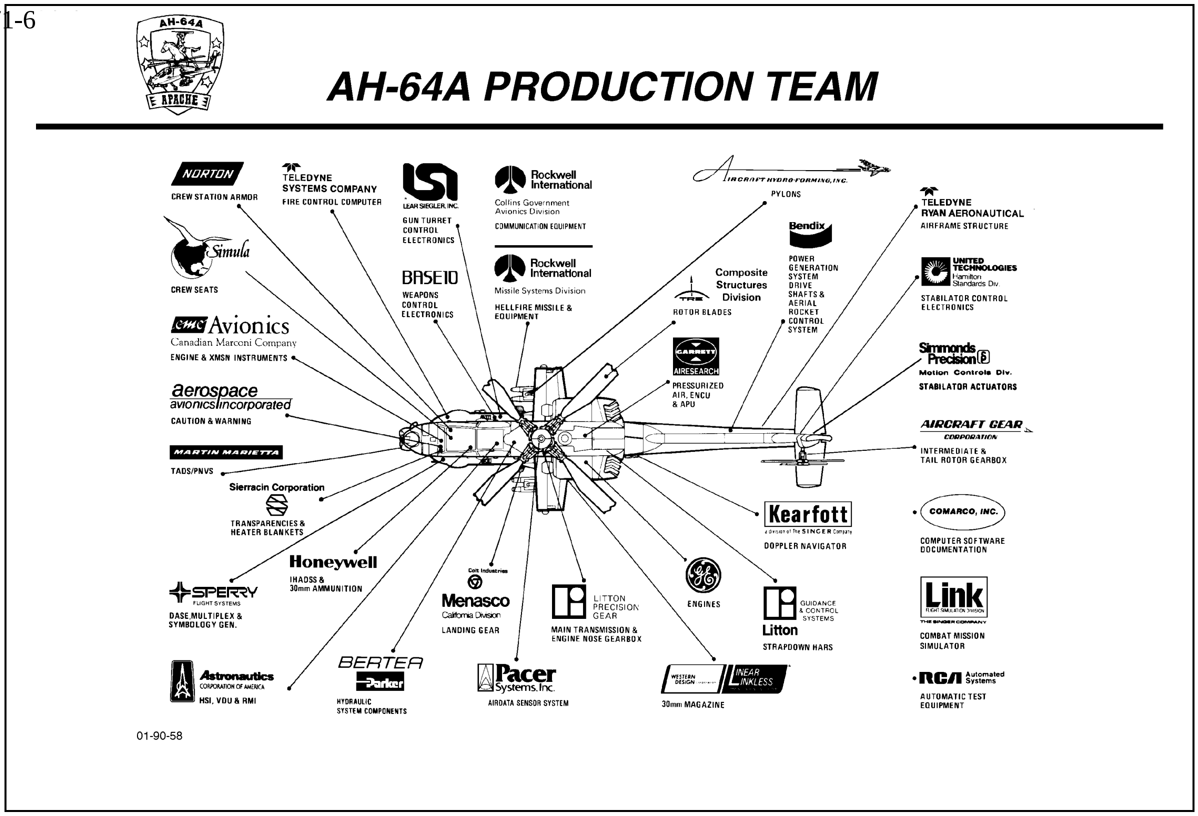
NOTES

k.	Jan 1979 to Jun 1984	Systems integration, developmental testing, and competition for subsystems development conducted at Yuma Proving Grounds, AZ.
l.	Mar 1979	YAH-64 successfully launches prototype Hellfire missile.
m.	Sep 1980	YAH-64 achieves top dive speed of 237 miles per hour.
n.	Apr 1981	AV02 logs 1000th flight hour; total flight hours on all Apache prototypes nears 2500.
o.	Aug 1981	Operational Test II (OT-II), a three month Army exercise to prove the operational effectiveness of the Apache prototype, is complete. Three YAH-64's participate in the testing.
p.	Aug 1981	YAH-64's log 3000 combined flight hours.
q.	Nov 1981	Apache prototypes demonstrate air transportability in C-141B transport aircraft.
r.	Mar 1982	AH-64A successfully qualifies for operations under icing conditions.
s.	Feb 1983	Apache prototypes log 4000 combined flight hours.
t.	Mar 1983	Full-scale Apache production is ahead of schedule, at the Apache assembly and flight test center in Mesa, AZ., as the first AH-64 fuselage arrives.
u.	Sep 1983	First production Apache rolls off the assembly line, two months ahead of schedule (30 Sep). First flight on 9 Jan 84.
v.	Jan 1984	First production AH-64 successfully completes initial flight at Mesa.
w.	Jan 1984	Hughes Helicopters becomes a subsidiary of McDonnell Douglas Corporation.
x.	Jan 1984	Army accepts first production AH-64, one month ahead of contract schedule.
y.	Mar 1984	Army instructor pilot and key personnel training begins.
z.	Jul 1984	Production and prototype Apaches reach 5000 total flight hours. With ground tests, Apaches have an overall operating time of more than 8000 hours.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AUTOMATIC TEST EQUIPMENT
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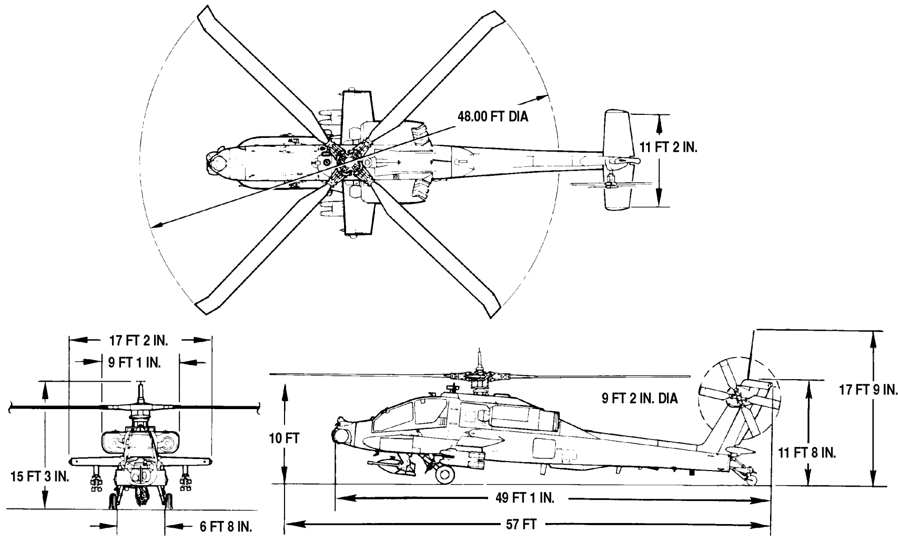
NOTES

aa.	Aug 1984	AH-64 Apache Production Vehicle 02 (PV02) fires first production Hellfire laser-guided missiles during testing at Yuma, AZ.
bb.	Aug 1984	Hughes retires AV02, the first AH-64A prototype, to fly, on Sep. 30, 1975, after nearly 2000 flight hours.
cc.	Oct 1984	Hughes delivers 11 AH-64As, completing the initial procurement contract awarded in Apr 1982.
dd.	Dec 1984	Total of 16 AH-64A production helicopters are delivered to the Army during 1984.
ee.	Jan 1985	First production AH-64A delivered to the Army on 17 Jan, 1985 and arrives at U.S. Army Aviation Training Center, Ft. Rucker, AL.
ff.	Jan 1985	First production AH-64A (PV03) is delivered to the U.S. Army Aviation Logistics School at Ft. Eustis, VA.
gg.	Apr 1985	Extensive self-deployment capability of the AH-64A is demonstrated during a 1175-statute-mile, nonstop, nonrefueled flight over Arizona and California. The aircraft, equipped with four 230-gallon external fuel tanks, completes the flight in eight hours.
hh.	Jun 1985	U.S. Army and Air Force personnel load six AH-64As into a C-5A transport aircraft in less than six hours to certify loading procedures for air deployment.

B. There are 35 major and over 400 subcontractors for the Apache.

AIRCRAFT DIMENSIONS



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NOTES

A. Aircraft dimensions

NOTE: All aircraft dimensions are not shown.

1. Height

a.	To top of omni-directional airspeed sensor	15 ft., 3 in.
b.	To top of rotor hub	12 ft., 7 in.
c.	From ground to main rotor blade	11 ft., 10 in. (static position, blade over nose)
d.	To top of vertical stabilizer	11 ft., 8 in. (static position)

2. Width

a.	Wing tip to wing tip	17 ft., 2 in.
b.	Stabilator tip to tip	11 ft., 2 in.
c.	Wings and stabilator removed	9 ft., 1 in.
d.	Axle to axle	6 ft., 8 in.

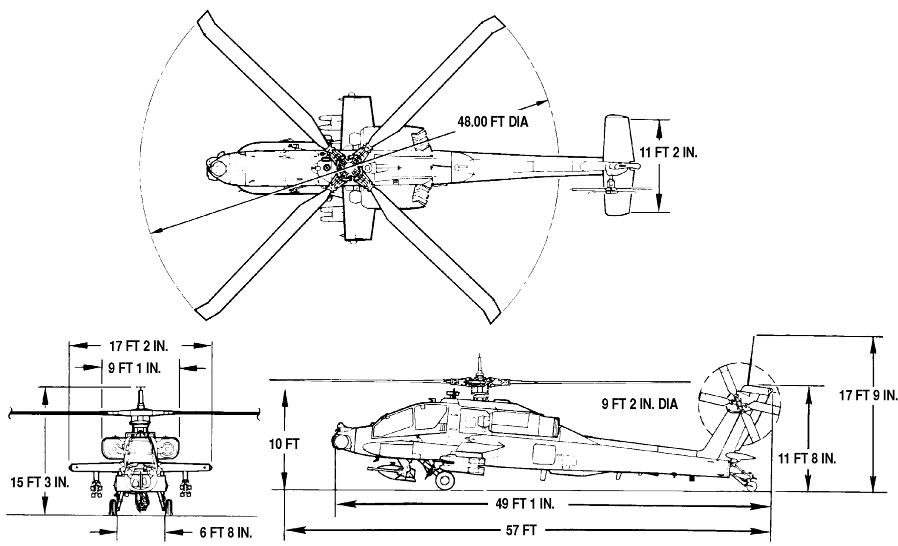
3. Length

a.	FS 0.0 reference datum line (RDL) to aircraft nose	6.08 in.
b.	Nose to aft tip of vertical stabilizer	49 ft., 1 in.
c.	Forward blade tip to aft tip of vertical stabilizer	57 ft.
d.	Main rotor blade tip to tail rotor blade tip	57 ft., 8 in.
e.	Target acquisition designation sight (TADS) turret to end of vertical stabilizer	49 ft., 1 in.

4. Rotor diameter

a.	Main rotor	48 ft.
b.	Tail rotor	9 ft., 2 in.

AIRCRAFT DIMENSIONS



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5. Rotor blade length

   a. Main — 20 ft., 10 in.

   b. Tail — 4 ft., 3 in.

6. Turning radius (one wheel locked) — 37 ft., 6 in.

7. Miscellaneous dimensions

   a. Static main rotor tip clearance — 10 ft.

   b. Zero cone M/R tip clearance — 11.77 ft.

   c. Main rotor to tail rotor clearance — 0.50 ft.

   d. Tail rotor tip to ground clearance — 5.38 ft.

B. Control authority

1. Collective pitch blade angle movement (from neutral collective position) — +9E to -9E

2. Collective stick full travel — 12.0 in.

3. Cyclic pitch range from neutral rigging position (collective mid position)

   a. +20E forward

   b. -l0E aft

   c. -10.5E left

   d. +7.0E right

4. Cyclic stick full travel

   a. Forward to aft stop — 10 in.

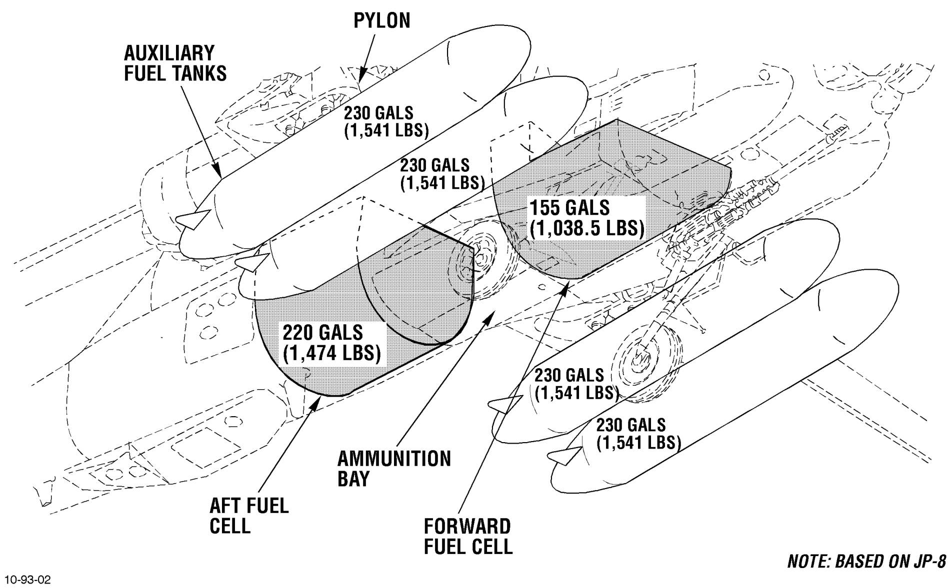
   b. Laterally — 9 in.

5. Range of tail rotor pitch angles — -15E +/- 1E to +27E +/- 1/2E

   (Right to left pedal travel)

6. Pedal travel — 5.5 in. (stop to stop)

FUEL CELL LOCATION/CAPACITY



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C. Fuel inventory (based on JP-4, standard day 6.5 lb. per gal)

1. Forward fuel cell capacity 155.7 gal./1,012.0 lb.

2. Aft fuel cell capacity 220 gal./1,430 lb.

3. Total fuel cell capacity 375.7 gal./2,442.0 lb.

4. Endurance, including reserve 2.5 hr.

5. Maximum fuel with auxiliary tanks 1,295 gal./8,417.5 lb.

6. Maximum Endurance including reserve 8.0 hr.

A. Levels of maintenance

1. Aviation Unit Maintenance (AVUM)

a. AVUM is responsible for all preventive maintenance and limited corrective maintenance functions.

b. The AVUM is any unit staffed to permit accomplishment of all preventive maintenance functions associated with preventive inspections (i.e., daily and special inspection requirements).

c. Preventive maintenance functions include cleaning, minor adjustments, and replacement of LRUs that are determined to be defective by the onboard fault detection/location system (FD/LS) or ground support equipment (GSE).

d. Removal or installation of equipment is accomplished with limited skills and GSE.

e. Such removal or installation does not require complex or critical adjustments or system alignment tasks.

f. GSE is highly mobile and is the minimum required to perform minor adjustments, diagnosis, and fault isolation to both components and LRUs.

g. Air vehicle maintenance

(1) Air vehicle maintenance functions are limited to inspection, cleaning, preserving, adjusting, replacing, riveting, and limited structural repair as authorized by the maintenance allocation chart.

(2) Maintenance functions associated with the engines, hydraulic, drive train, electrical systems, and rotors is limited to diagnostic procedures, minor repair, and replacement of LRU assemblies and components (e.g., transmission).

h. Subsystem maintenance functions

(1) Subsystem maintenance functions are limited to preventive maintenance, external adjustments, operational checks, calibration, and alignments using GSE, as authorized by the maintenance allocation chart.

(2) These functions have the capability to analyze subsystem malfunctions to the defective LRU using built-in test equipment (BITE), equipment self-test capability, annunciator panel displays, or noncomplex GSE.

(3) Repair functions are limited to replacement of LRUs and components which are easy to remove/install.

2. Aviation Intermediate Maintenance (AVIM)

   a. Air vehicle maintenance

      (1) AVIM effort is concentrated on tasks associated with repair of components and assemblies for return to the user and the direct exchange program.

      (2) AVIM effort inspects, troubleshoots, diagnoses, tests, adjusts, calibrates, and aligns components and assemblies to include such items as helicopter electrical components, hydraulic components, instruments, flight control components, propulsion systems, and drive train systems.

      (3) AVIM effort also repairs components and assemblies using parts authorized by the maintenance allocation chart.

      (4) Component disassembly and repair is limited to tasks that can be performed using the defined GSE and authorized spares. Repairs requiring extensive machining, rework, or repair parts support is not performed.

   b. Equipment maintenance

      (1) Equipment maintenance, particularly that associated with systems such as the area weapon, point target, TADS, and pilot night vision sensor (PNVS), requires replacement/repair of modules, submodules and power supplies within the LRUs.

      (2) Repair of modules including wired/printed circuit cards, is accomplished at the AVIM level, based on efficient and economical use of GSE and spares and the skill level of authorized personnel.

      (3) GSE at this maintenance level includes computerized automatic test equipment.

      (4) AVIM efforts provide forward maintenance support and technical assistance through the use of mobile contact teams.

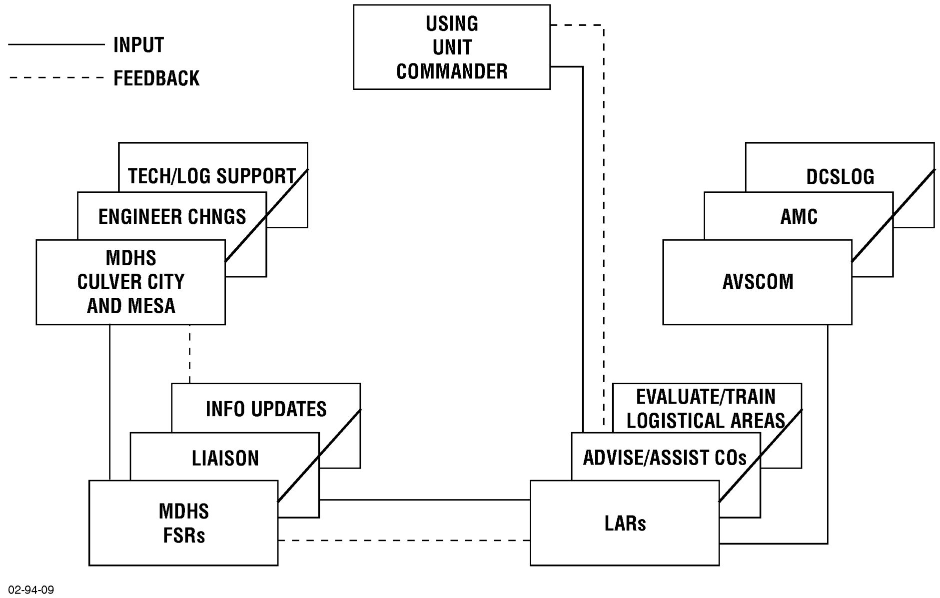
3. Depot-level maintenance overhauls/repairs components, assemblies, or LRUs as required.

4. Logistics assistance

   a. Establishes and manages a worldwide logistics assistance program for equipment and systems.

   b. Serves as the readiness and supportability feedback loop from the user to the Apache Program Manager's Office.

FIELD SERVICE REPRESENTATIVE MISSIONS



NOTES

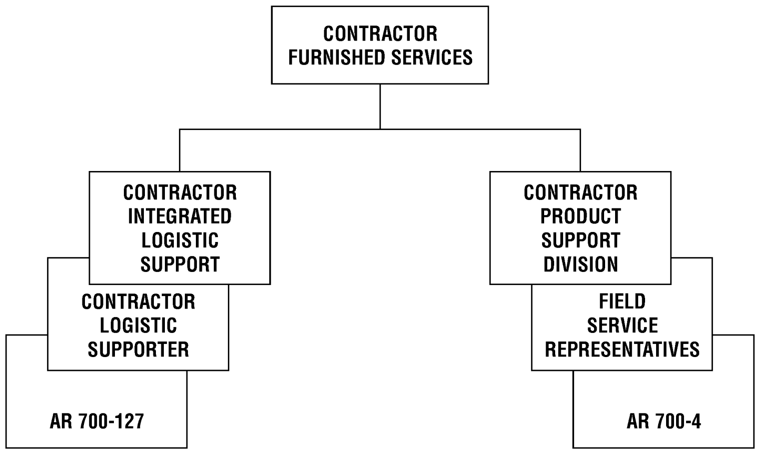
5. Field Service Representative (FSR) mission

    a. Overall mission - provide liaison and advisory services between contractors and the Army.

    b. Primary mission - transmit the knowledge necessary to update Army personnel with information required for equipment operation and maintenance.

    c. Secondary mission - provide on-the-spot advice to Army personnel and logistics assistance representatives (LARs) to resolve technical problems associated with the aircraft or components.

CONTRACTOR FURNISHED SERVICES



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NOTES

6. Contractor furnished services

a. Logistics aspect

(1) Ensure logistical support for management of spares inventory.

(2) Provides recommendations for AVUM prescribed load list (PLL), AVIM authorized stockage list (ASL), and stocks of contractor-furnished equipment (CFE) Depot Maintenance items.

(3) Inventory support is keyed to aircraft status, not mission capable supply (NMCS), partially mission capable (PMCS), fully mission capable (FMC) with requisition response time goals of 3, 5 and 45 days respectively.

b. Maintenance aspects

(1) Ensures repair parts, special tools, and test measurement and diagnostic equipment (TMDE) is on hand for repair and overhaul of CFE black boxes, systems, and subsystems.

(2) Provides overhaul facilities for CFE black boxes, systems, and subsystems. Provides AVUM/AVIM personnel to support the production program.

A. Inspection criteria

1. General inspection requirements are listed in TM 1-1520-238-23, paragraph 1-367 and TM 1-1500-328-23, Section II, paragraph 2-1.

2. The frequency and depth of inspections is determined by estimated failure rates, effect of failures on the system, propagation time of the failure, and man-hours required to test or inspect for the failure modes.

3. Daily inspections reference TM 55-1520-238-PMS, as required.

4. Lube and service requirements reference TM 1-1520-238-23, paragraph 1-17.

5. Army Oil Analysis Program references TB 43-0106 and TB 55-1500-334-15 as required.

6. Phased maintenance references TM 1-1520-238-PM as required.

7. Special inspections reference TM 1-1520-238-23, paragraphs 1-136.

   a. Calendar

   b. Safety of flight

   c. Estimated cost of damage

8. Overhaul and retirement schedule references TM 1-1520-238-23, paragraph 1-404.

   a. The overhaul and retirement schedule lists parts, and total operating times for when they must be replaced.

   b. Parts can be replaced during the inspection prior to the time replacement is due. Exceptions to this are listed in TM 1-1500-328-23.

   c. Removed parts are either overhauled or discarded during replacement.

   d. The schedule has five headings.

      (1) Part name - an asterisk preceding the part name indicates an indentured subassembly.

      (2) Part number - check TM 55-1520-238-23P for part numbers of replacement parts.

      (3) Overhaul interval hour - maximum operating time allowed on the part before it is to be overhauled.

(4) Retirement interval hours/days - maximum operating time allowed on the part before it is removed and condemned.

(5) Retirement interval notes - all retirement life items will have a Demil code of "L" and will be mutilated in accordance with DOD 4160.21-M-1, Defense Demilitarization manual and TM 1-1500-328-23, Aeronautical Equipment Maintenance Management Policies and Procedures.

e. All forms, records, and work sheets required by DA-PAM 738-751 must be filled out when parts are replaced.

B. Fuselage inspection, damage limits, and repair criteria reference TM 1-1520-238-23, page 2-35 (Fuselage Inspection Procedures).

1. The AH-64 helicopter consists of aluminum, magnesium, titanium, nickel, various types of steel, Kevlar, plastic, and other composites.

2. The fuselage is primarily aluminum alloy, semi-monocoque design, with sixteen major bulkheads and four major longerons (additional intermediate frames and stringers are provided as required).

3. Magnesium is utilized mainly in gearboxes and housings. Steel exists primarily in the form of housings, bearings, races, and fasteners.

4. Kevlar is used for major fairings, and other composites are used for armor protection, windows, and crew station equipment.

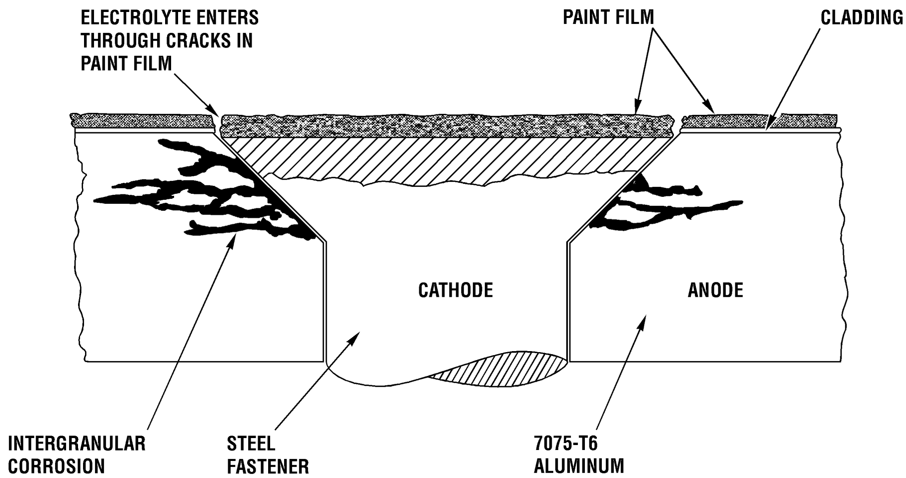
5. There are three categories of repair criteria.

a. Category A - negligible damage, repair at first opportunity.

b. Category B - minor damage, repair immediately with temporary repair.

c. Category C - major damage, immediate component or part replacement is required.

CORROSION SITUATION EXAMPLE



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NOTES

C. Corrosion identification and types

1. Corrosion is defined as the deterioration of a metal by reaction to it's environment.

2. Corrosion starts as soon as a metal part is manufactured and continues throughout the life of the part.

3. For the purpose of this discussion corrosion is considered an electrochemical process. Four conditions must exist before electrochemical corrosion can occur.

   a. Corroding element or a positive electron (anode)

   b. Negative electron (cathode)

   c. Continuous liquid path (electrolyte and salt, or other contaminate)

   d. Conductor to carry flow of electrons from anode to cathode

4. Elimination of any one of the four conditions stops corrosion. For example, an organic film on the surface of the metal prevents the electrolyte from connecting the cathode and anode. The current does not flow, and corrosion does not occur.

5. Types of corrosion

   a. Uniform etch

      (1) Caused by a direct chemical attack, such as from acids.

      (2) Indications are a general dulling and roughness of the surface.

   b. Pitting

      (1) Most common on aluminum and magnesium alloys.

      (2) Indications are white or gray powdery deposits, tiny pits, or holes.

   c. Intergranular

      (1) Located in the grain of metal alloys.

      (2) Cannot be seen from exterior surfaces.

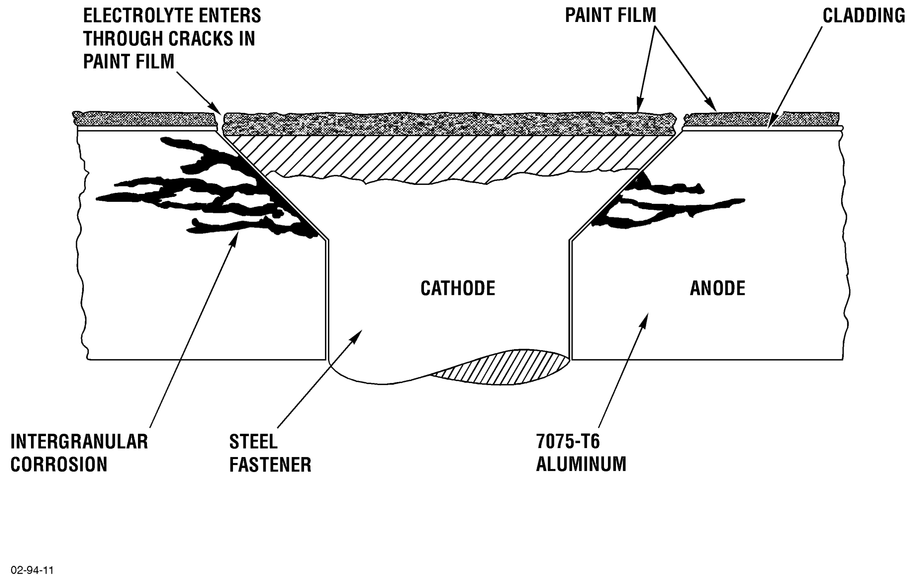
   d. Exfoliation

      (1) Progresses parallel to metal surface.

      (2) Underlying layers gradually separate.

      (3) Indications are a lifting-up or swelling of the metal.

CORROSION SITUATION EXAMPLE



NOTES

e. Galvanic

(1) Occurs when dissimilar metals are in constant contact.

(2) Indications are a buildup of corrosion at the point of contact between the metals.

f. Stress corrosion cracking

(1) Caused by the effects of constant tensile stress and corrosion.

(2) Stress may be internal or externally applied.

g. Fatigue

(1) Caused by combined effects of cyclic stress and corrosion.

(2) No metal is immune in a corrosive environment.

6. The appearance of corrosion on the AH-64A is primarily related to the three types of metal used in the helicopter (steel, aluminum, and magnesium).

a. Corrosion on aluminum appears as a white or gray powder. A slightly yellow color is caused by an alodine coating used on some aluminum parts.

b. Corrosion on steel appears as rust, or a reddish brown scaling or flaking on the surface.

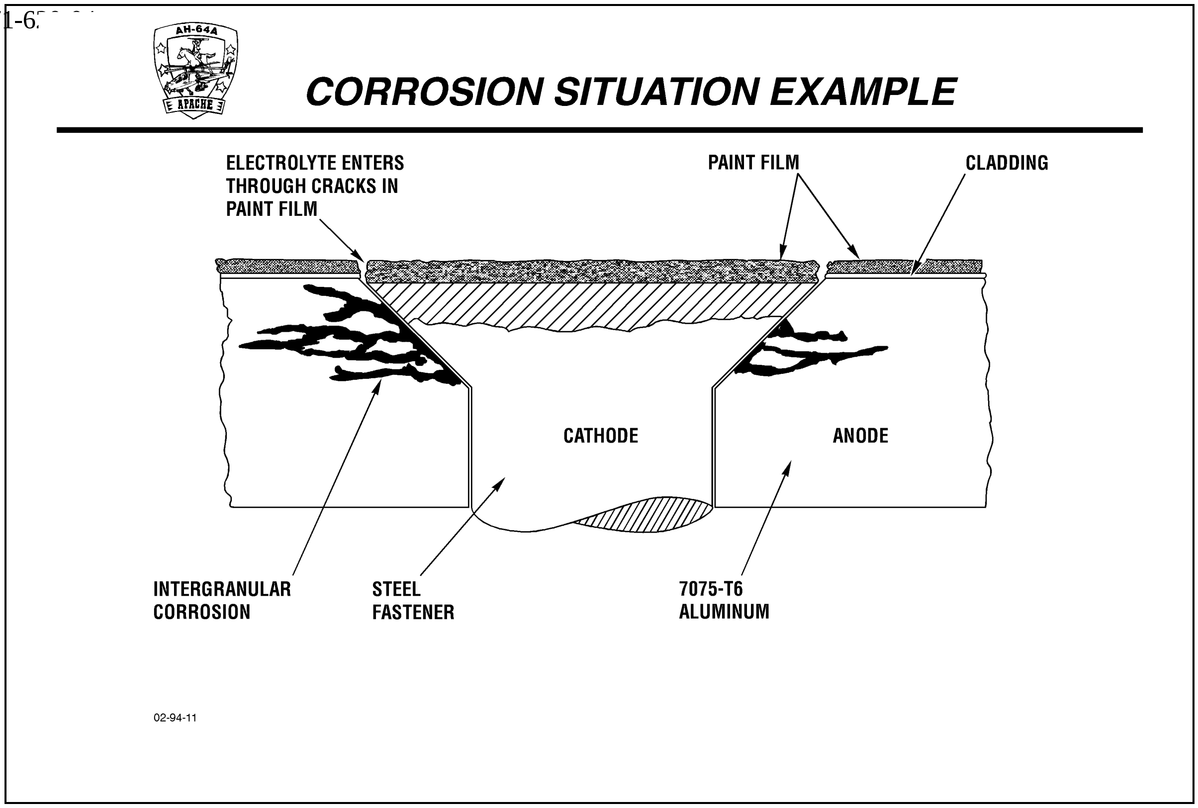
c. Corrosion on magnesium appears as white powdery snow-like mounds, and white spots on the surface.

7. Corrosion prevention maintenance procedures

a. Specific corrosion control requirements can be found in Volume 1 of TM 55-1520-238-23. Detailed corrosion control procedures are found in TM 43-0105 and TB 746-93-2.

b. The Commander shall provide a definite preventive maintenance schedule for the inspection and cleaning of assigned aircraft, depending upon the weather, the environment, and usage of the aircraft. Preventive maintenance is necessary to retard corrosion of aircraft equipment.

c. A properly exercised corrosion prevention/control program will disclose corrosion in the early stages. Minor maintenance can correct such corrosion, while advanced corrosion requires extensive maintenance and/or repairs. Preventive maintenance is the most effective and least time consuming method of controlling corrosion.


AH-64A
APACHE
CORROSION SITUATION EXAMPLE
ELECTROLYTE ENTERS THROUGH CRACKS IN PAINT FILM
PAINT FILM
CLADDING
CATHODE
ANODE
INTERGRANULAR CORROSION
STEEL FASTENER
7075-T6 ALUMINUM
02-94-11

NOTES

d. Frequent inspection, cleaning, and related treatment is necessary to remove corrosive agents that are continually deposited on metal surfaces.

e. Cleaning and related treatments outlined in the technical manuals is accomplished whenever inspections indicate the work is required.

f. The treatment (emergency or routine) of corrosion as it occurs and restoration, or touch up of protective finishes is necessary after corrosion control has been accomplished.

8. General cleaning processes

a. Properly performed cleaning processes extend service life, increase reliability and availability, provide a greater margin of safety, decrease the overall operation and maintenance cost, and maintain the appearance of the equipment.

b. Corrosion is a major problem affecting the material readiness of present-day equipment. Proper and attentive cleaning is one method that must be utilized to minimize the effect of corrosion and deterioration caused by the environment.

c. Cleaning techniques are no longer a simple process of applying a soap solution and scrubbing. Different materials and equipment require separate, or individual, cleaning processes.

d. Properly performed cleaning processes require experienced and adequately trained personnel. Personnel must be trained in cleaning operations and in detection and treatment of corrosion.

e. Only authorized methods and materials specified in the TMs shall be used unless authorization for deviation is obtained from the Army Aviation Systems Command.

9. Safety and precautionary measures

a. Some methods require use of materials that may injure personnel.

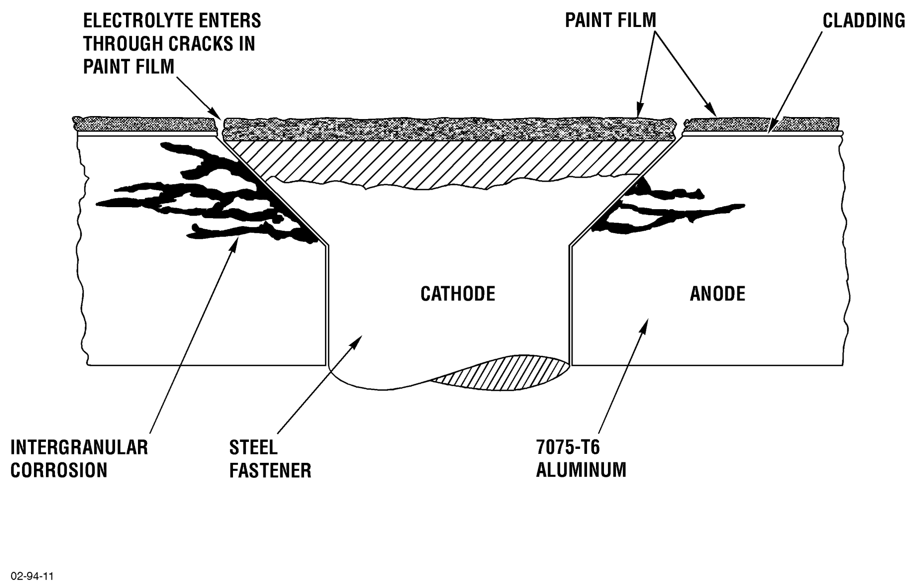
b. Protective clothing and equipment such as rubber gloves, face and eye shields, aprons, boots, approved organic vapor cartridge respirators or supplied-air respirators, shall be used as required to provide adequate protection for personnel.

10. Types of cleaners

a. Alkaline Cleaners

(1) Removes soil by displacement from the surface rather than by direct solution in the cleaner.

CORROSION SITUATION EXAMPLE



NOTES

(2) Usually have components that aid in lifting soils from a surface.

b. Solvents

(1) Cleans by dissolving the soil.

(2) Usually leaves a thin film or oil residue.

c. Acid cleaners

(1) Removes soil by chemical attack and dissolving the reaction products.

(2) Usually used to remove corrosion products.

d. Mechanical

(1) Removes soil by physical action, such as scraping, brushing, wiping, or sanding.

(2) Usually used with other types of cleaners.

11. Methods of cleaning

a. Hand cleaning

(1) Used where the volume of work to be cleaned is too small, or the parts too large to justify the expense of special equipment.

(2) Cleaning solution may be applied by means of brushes, swabs, or cloths.

b. Corrosion cleaning. Use the authorized methods and materials as stated in TM 55-1520-238-23 and TM 55-1500-344-23 for cleaning corrosion.

12. Insulation of dissimilar metals

a. Prior to assembly of repair or replacement parts, make certain that all existing corrosion has been removed and that the parts are properly insulated from each other.

b. Where corrosion exists, remove the corrosive products and the protective finish around the area.

c. Protective coatings must be reapplied to prohibit corrosion after removal.

A. Ground handling

1. Safety (TM 1-1520-238-23, paragraph 1-7-2)

2. Towing (TM 1-1520-238-23, paragraph 1-7-23)

3. Mooring (TM 1-1520-238-23, paragraph 1-7-22)

4. Tiedown and protective cover installation (TM 1-1520-238-23, paragraph 1-7-51 and 1-7-52 for tiedown, paragraphs 1-7-4 and 1-7-5 for protective covers)

5. Jacking (TM 1-1520-238-23, paragraphs 1-7-11 through 1-7-15)

6. Storage (TM 1-1520-238-23, Appendix E, paragraphs E-1-1 through E-2-6)

7. Sling Operations (TM 1-1520-238-23, paragraph 1-7-24)

8. Hoist Operations (TM 1-1520-238-23, paragraphs 1-7-42 through 1-7-50)

A. Weight and balance general information

1. The AH-64 is a class 2 aircraft. Class 2 aircraft are those whose weight or center of gravity limits can readily be exceeded by loading arrangements normally used in tactical operations. Therefore, limited loading control is needed.

2. The aircraft is weighed every 24 months. It is weighed in a 3.5E nose up attitude. The arm determined, is converted to a level flight attitude reference arm for all subsequent calculations.

3. Ultimately, it is the pilot's responsibility to insure that the weight and balance conditions of the aircraft are within safe limits.

B. Design weight criteria

1. Empty weight is 11,226 pounds (5,096.6 kilograms).

2. Minimum flying weight is 11,500 pounds (5,221.0 kilograms).

3. Basic design structural gross weight is 14,660 pounds (6,655.6 kilograms).

4. Design primary mission gross weight is 14,780 pounds (6,710.1 kilograms).

5. Design maximum alternate gross weight is 17,650 pounds (8,013.1 kilograms).

6. Design extended range gross weight is 21,000 pounds (9,534.0 kilograms).

C. Definitions

1. Empty Weight - the weight of the aircraft structure plus the power plants, instrument, control, hydraulic, electrical, and communication systems, armament provisions, furnishings, anti-icing equipment, and the auxiliary power plant.

2. Basic weight - the basic weight of the AH-64A including all fixed operating equipment, all hydraulic fluid, oil, and both trapped and unusable fuel.

3. Operating weight - the operating weight of the helicopter is the basic weight plus aircrew, baggage, emergency, and required mission equipment. This does not include fuel and ammunition.

4. Gross weight - the gross weight is the total weight of the helicopter and its contents.

5. Takeoff gross weight - is the operating weight plus fuel, cargo, ammunition, auxiliary fuel, etc.

6. Landing gross weight - is the takeoff gross weight minus the items expended during flight.

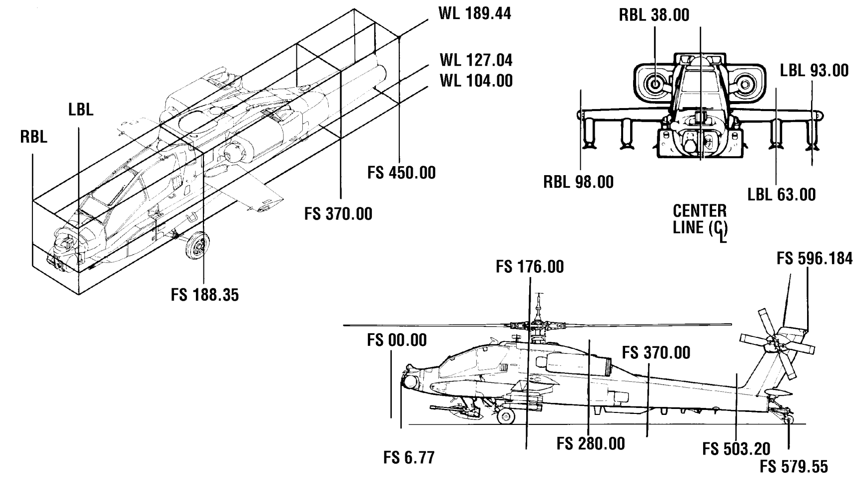
7. Useful Load - is the difference between empty weight and gross weight and includes fuel, oil, crew, cargo, and other materials carried.

8. Reference datum line (RDL) - the reference datum is an imaginary vertical plane from which all horizontal distances are measured (in inches) for balance purposes.

9. Arm - for balance purposes, arm is the horizontal distance (in inches) from the reference datum to the center of gravity of a given item. For the AH-64A, arm and fuselage station (FS) are the same.

10. Moment - moment is the weight of an item multiplied by its arm. For the AH-64A helicopter, moment divided by 100 (moment/100) simplifies calculations by reducing the number of digits.

AIRFRAME STATION LOCATION



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NOTES

11. Aircraft fuselage station (FS) - a position measured from a plane perpendicular to the aircraft longitudinal axis. The number designation of this station signifies its distance from the RDL.

12. Average arm - the arm obtained by adding the weight and moments of a number of items and dividing the total moment by the total weight.

13. Basic moment - this is the sum of the moments of all items making up the basic weight. When using data from an actual weighing, the basic moment is the total moment of the basic helicopter with respect to the reference datum.

14. Center of gravity (CG) - The point about which the helicopter will balance, if suspended. Distance from the RDL is found by dividing the total moment by the gross weight of the helicopter.

15. CG limits - the extremes of movement to which the helicopter CG can travel without degrading performance. The CG of the loaded helicopter must remain within these limits during all operation.

CREW WEIGHT TABLE

Crew Member Weight Including Equipment (lb)	Copilot Station		Pilot Station	
	Nominal Arm (in.)	Moment (in.-lb/100)	Nominal Arm (in.)	Moment (in.-lb/100)
100	82.2	82	143.3	143
110	82.2	90	143.3	158
120	82.2	99	143.3	172
130	82.2	107	143.3	186
140	82.2	115	143.3	201
150	82.2	123	143.3	215
160	82.2	132	143.3	229
170	82.2	140	143.3	244
180	82.2	148	143.3	258
190	82.2	156	143.3	272
200	82.2	164	143.3	287
210	82.2	173	143.3	301
220	82.2	181	143.3	315
230	82.2	189	143.3	330
240	82.2	197	143.3	344
250	82.2	206	143.3	358

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NOTES

D. Weight and balance charts

1. Personnel moment table - determines pilot and CPG moment, given actual weights.

2. Folding fin aerial rocket (2.75 in.) launcher moment table - determines the moment of the different types of launchers at different positions on the wings.

3. Ammunition moment table - determines the weight and moment of different types of ammunition.

4. Hellfire missile table - determines the weight and moment of missile launchers and missiles.

5. Fuel moment chart and fuel loading table (3 types of fuel) - determines the moment of fuel on board the aircraft.

6. Chaff table - determines the moment of the chaff dispenser and 30 chaff cartridges.

7. Center of gravity table - determines center of gravity and center of gravity limits.

E. Weight and Balance Formula

1. Weight and balance computations are based on a triangle formula.

   a. Moment = weight x arm.

   b. Arm = moment) weight.

   c. Weight = moment) arm.

2. Divide all moment computations by 100 for logging on DD 365-4.

F. Weight and Balance Clearance Form, DD Form 365-4

071

WEIGHT AND BALANCE FORM 365-4

02-94-13

WEIGHT AND BALANCE CLEARANCE FORM F - TACTICAL

(Use reverse for transport missions)

FOR USE WITH T.O. 1-1B-40,NAVAIR 01-1B-40, AND TM-55-1500-342-23

DATE (YYMMDD)	AIRCRAFT TYPE	FROM	HOME STATION
MISSION	SERIAL NO.	TO	PILOT

CORRECTION/MOST FWD/MOST AFT *(Ref.11)*

COMPT	ITEM	CHANGES *(+ or -)* WEIGHT	CHANGES *(+ or -)* INDEX OR MOM/
TOTAL WEIGHT ADDED		+	+
TOTAL WEIGHT REMOVED		-	-
NET DIFFERENCE *(Ref.11)*			

REMARKS

REF	ITEM	WEIGHT	INDEX OR MOM/
1	BASIC AIRCRAFT *(From Chart C)*		
2			
3 DISTRIBUTION OF LOAD	COMPT / CREW NO. / CREW WEIGHT / CARGO/MISC		
4	OPERATING WEIGHT		
5 AMMO			
6 BOMBS, MISSILES, ETC.			
7 FUEL			
8	MISC. VARIABLES		
9	TAKEOFF CONDITION *(Uncorrected)*		
10	TAKEOFF C.G. IN % M.A.C. OR IN		
11	CORRECTIONS *(If required)*		
12	TAKEOFF CONDITION *(Corrected)*		
13	TAKEOFF C.G. IN % M.A.C. OR IN		
14	TAKEOFF FUEL		
LESS EXPENDABLES			
15	ESTIMATED LANDING FUEL		
16	ESTIMATED LANDING CONDITION		
17	ESTIMATED LANDING C.G. IN % M.A.C. OR IN		

LIMITATIONS

GROSS WT. TAKEOFF *(lb.)*	GROSS WT. LANDING *(lb.)*	
PERMISSIBLE C.G. TAKEOFF *(% M.A.C. or in.)*	FORWARD	AFT
PERMISSIBLE C.G. LANDING *(% M.A.C. or in.)*	FORWARD	AFT

COMPUTED BY SIGNATURE

WEIGHT AND BALANCE AUTHORITY SIGNATURE

PILOT SIGNATURE

DD Form 365-4 Reverse, APR 89

NOTES

1. The normal basic weight of the AH-64A includes the wing pylons, all fixed operating equipment, 30mm gun, all oil, and trapped fuel.

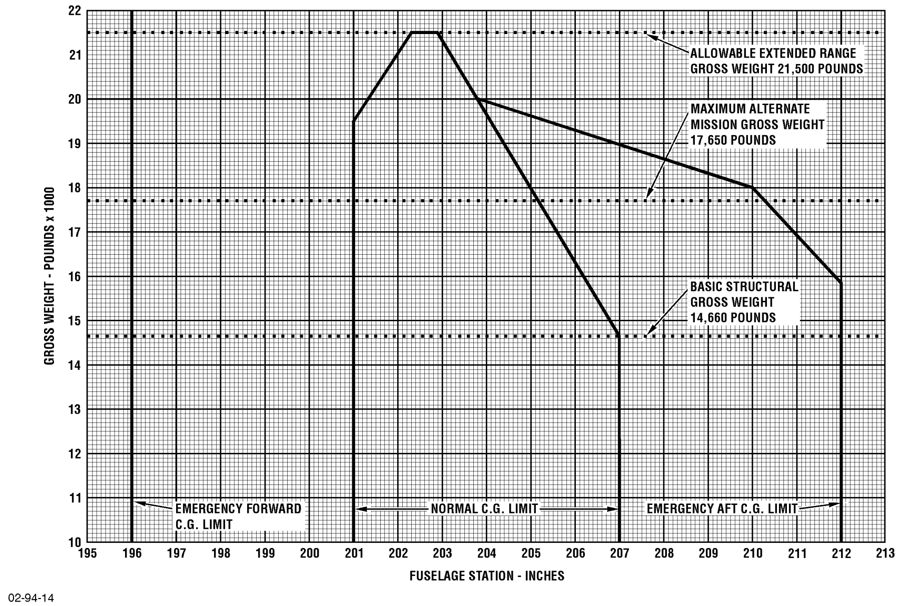
2. Example DD Form 365-4 (Take-off)

	Weight (lb)	Moment (in-lb ~ 100)
Basic Weight (with pylons)	11,995	25,070
Copilot/Gunner	200	164
Pilot	200	287
30mm Ammunition (400)	308	585
Rocket Launchers (2)	173.6	344
Hellfire Launchers (2)	278.2	528
Hellfire Missiles (8)	788	1,502
Chaff Dispenser	7.2	36
30 Chaff	10	49
Fwd Fuel (130.8 gal., JP-4)	850	1,280
Aft Fuel (130.8 gal., JP-4)	850	2,168

3. Example DD Form 365-4 (Landing)

30mm Ammunition (400)	0	0
Hellfire Missiles (8)	0	0
30 Chaff	0	0
Fwd Fuel (23.1 gal., JP-4)	200	301
Aft Fuel (23.1 gal., JP-4)	200	510

LONGITUDINAL CENTER OF GRAVITY LIMITS



NOTES

NORMAL LONGITUDINAL CENTER OF GRAVITY LIMITS

21,000 LB ALLOWABLE MAXIMUM GROSS WEIGHT WITH AUXILIARY TANKS

17,650 LB MAXIMUM MISSION GROSS WEIGHT WITHOUT AUXILIARY TANKS

EXAMPLE

WANTED

DETERMINE IF LOADING LIMITS ARE EXCEEDED AND FIND C.G. POSITION

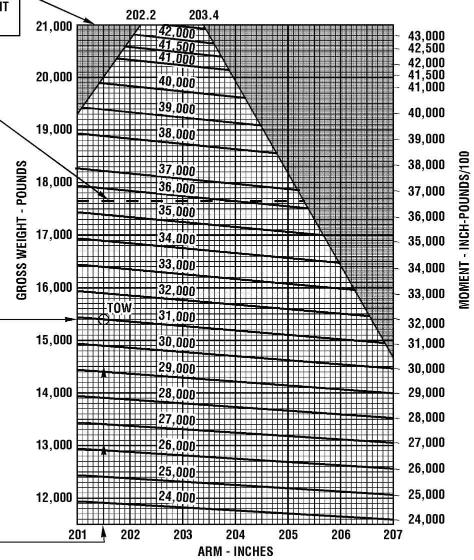
KNOWN

G.W. = 15,385 LBS
MOMENT/100 = 31,000
C.G. = 201.5

METHOD

ENTER GROSS G.W. WEIGHT HERE

MOVE RIGHT TO MOMENT (31,000)
MOVE DOWN READ
C.G. 201.5



ENTER ARM HERE

02-94-15

NOTES

G. Center of gravity limits

1. Longitudinal CG limits

a. The Longitudinal CG limits were established for stability and control purposes at fuselage station 201.0 forward and fuselage station 207.0 aft. At the higher gross weights, longitudinal limits were dictated by structural considerations.

(1) Most forward - fuselage Station 201.0 (gross weight to 19,400 lbs).

(2) Most forward - linear variation from fuselage Station 201.0 to 202.0 (gross weight from 19,400 lbs to 20,600 lbs.).

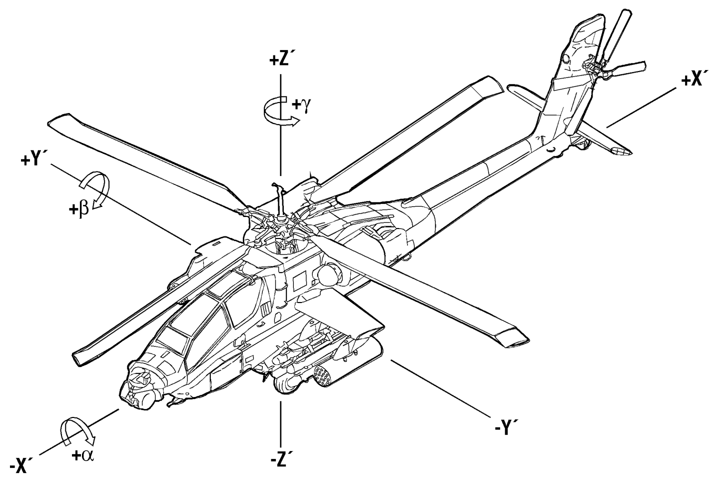
(3) Most aft - fuselage Station 201.0 (gross weight to 14,660 lbs.)

(4) Most aft - linear variation from Fuselage Station 207.0 to 203.2 (gross weight from 14,600 lbs. to 20,600 lbs.).

2. Coordinate system

HELICOPTER STABILITY AXIS

X = FUSELAGE	(AFT = +)	ROTOR ℄ = 198.61
Y = BUTTOCK LINE	(RIGHT = +)	SHIP ℄ = 0.0
Z = WATERLINE	(UP = +)	ROTOR ℄ = 215.94



NOTES

a. Center-of gravity coordinates shown herein use the following nomenclature and coordinate system.

(1)	X = Fuselage	(aft = +)	rotor C/L = 198.61
(2)	Y = Buttline	(Right = +)	ship C/L = 0.0
(3)	Z = Waterline	(up = +)	rotor C/L = 215.94

3. Design CG criteria

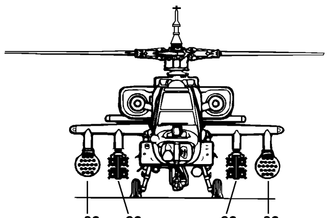
a. The normal CG limits published in the operator's manual represent the normal and authorized operating envelope.

b. The design emergency critical forward limit will be reached if the tail rotor and/or tail rotor gear box have separated from the aircraft.

c. The critical aft emergency longitudinal CG is reached when the forward fuel tank is empty and the aft fuel tank is full, and a lighter than normal crew.

4. Lateral center of gravity limits and envelope

LATERAL CG COMPUTATION PROCEDURE



	TYPE OF WING STORES	WEIGHT	x	BUTT LINE	=	MOMENT
*AIRCRAFT GW		14500	x	0	=	0
RIGHT INBD	EXT FUEL TANK	140	x	+63	=	+8820
	JP5	1564	x	+63	=	+98532
RIGHT OUTBD	HF	141	x	+93	=	+13113
			x	+93	=	
LEFT INBD	ROCKET POD	86.8	x	-63	=	-5468.4
			x	-63	=	
LEFT OUTBD	HF	141	x	-93	=	-13113
	MISSILES	403.5	x	-93	=	-37525.5
	TOTAL WEIGHT	16976.3		TOTAL MOMENT		+64358.1

$\frac{\text{TOTAL MOMENT}}{\text{TOTAL WEIGHT}}$ = CENTER OF GRAVITY

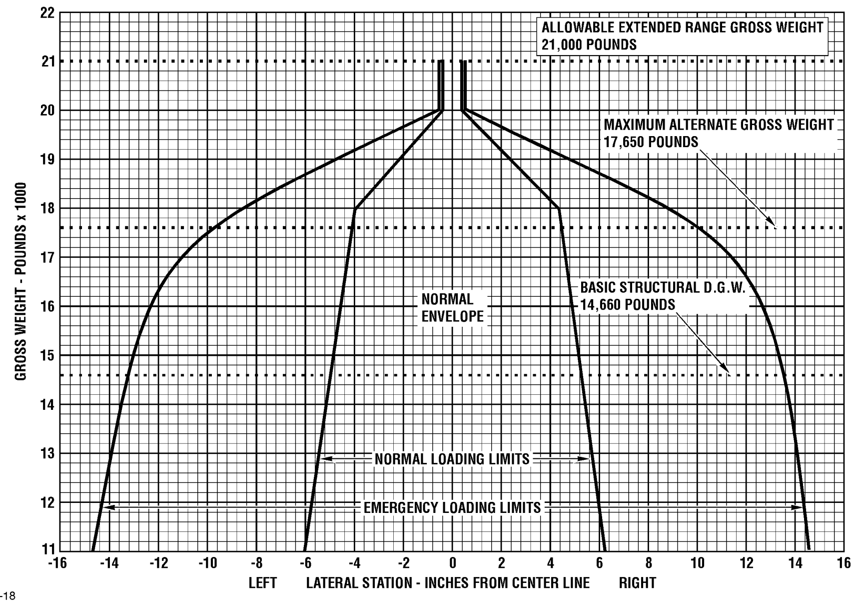
CENTER OF GRAVITY = +3.7910557

*AIRCRAFT GW = BASIC WEIGHT (CHART C), PILOT'S WEIGHT, INTERNAL FUEL TANKS FULL OF FUEL WEIGHT, AND EXTERNAL FUEL TANK'S PLUMBING WEIGHT.

02-94-17

NOTES

LATERAL CG ENVELOPE AND LIMITS



NOTES

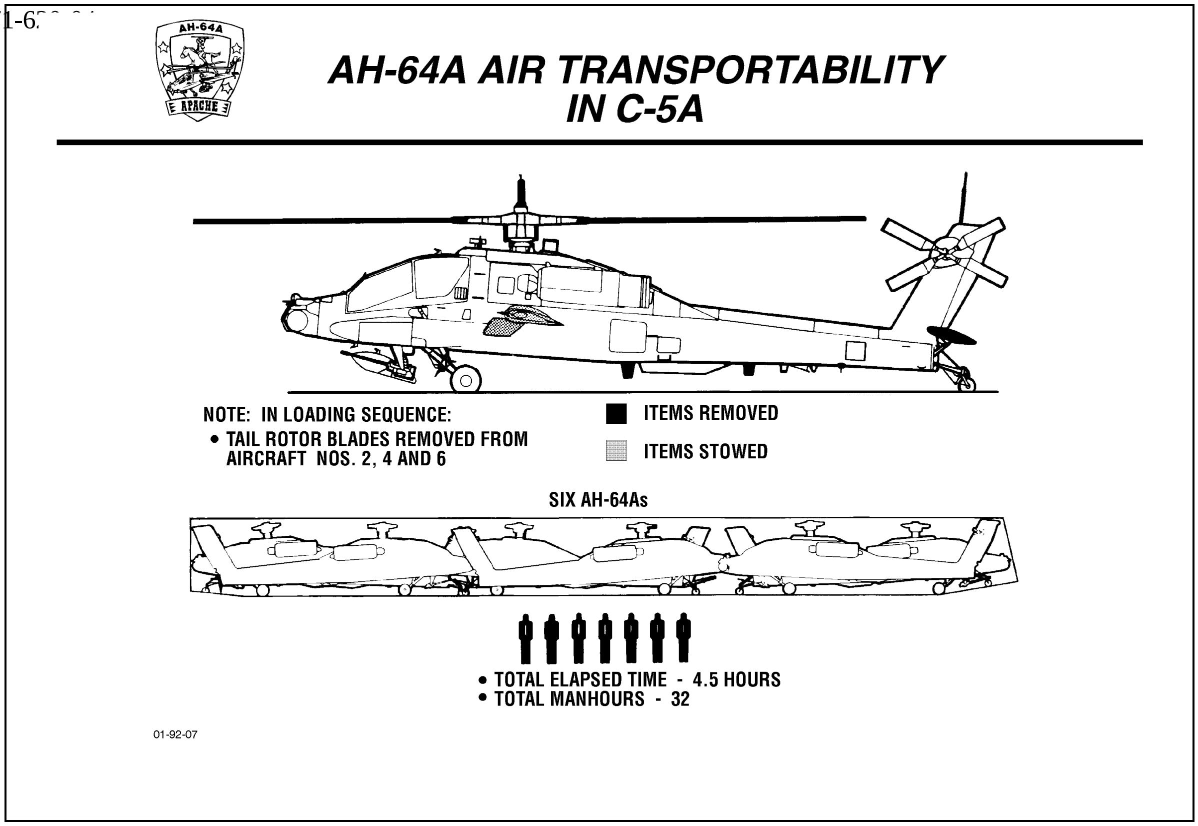
a. The lateral center of gravity limits below gross weights of 18,000 pounds were established for stability and control purposes. For gross weights above 18,000 pounds, the lateral limits are dictated by structural considerations of the landing gear. Emergency center of gravity limits are controllability limits.

(1) The normal lateral center of gravity envelope critical points were determined by superimposing the envelope diagram for each of the missions and identifying the extreme points.

(2) Asymmetrical stores configurations

(a) Most critical normal. Any one store weighing up to 700 pounds on the outboard station (buttline 93) on one wing. No stores on inboard station or on the other wing (buttlines 63 and 93).

(b) Most critical emergency. Any two stores weighing up to 950 pounds each on one wing (buttlines 63 and 93) and no stores on the other wing. Or, any store weighing up to 1620 pounds on an outboard store station (buttline 93) and no stores on inboard store station or on the other wing.


AH-64A
APACHE
AH-64A AIR TRANSPORTABILITY
IN C-5A
NOTE: IN LOADING SEQUENCE:
• TAIL ROTOR BLADES REMOVED FROM AIRCRAFT NOS. 2, 4 AND 6
ITEMS REMOVED
ITEMS STOWED
SIX AH-64As
• TOTAL ELAPSED TIME - 4.5 HOURS
• TOTAL MANHOURS - 32
01-92-07

NOTES

A. Preparation for shipment (Aircraft)

1. Characteristics of shipment by aircraft

a. Provides rapid delivery of helicopters to deployment area.

b. Moderate to relatively extensive disassembly is required.

c. Tight spacing and precise positioning is required.

(1) C-5A aircraft can carry a maximum of 6 AH-64As, with limited disassembly, requiring 32 man-hours (covered in TM 55-1520-238-S).

(a) The following items must be removed

1) Air Data Sensor

2) Main Rotor Blades

3) Stabilator

4) VHF #1 Antenna

5) VHF #2 Antenna

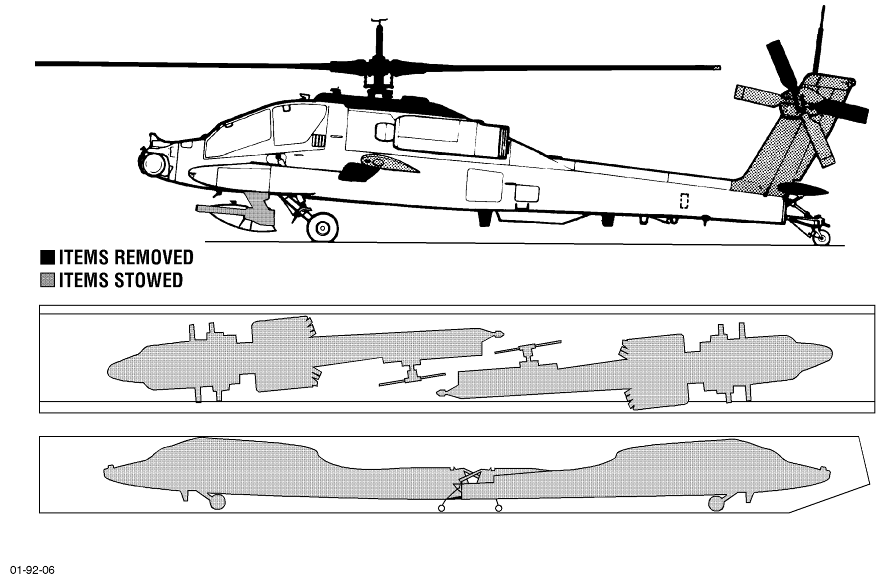
6) UHF Antenna

(b) The following items must be stowed

1) Wings

2) Pylons

AIR TRANSPORTABILITY - C-141B



NOTES

(2) C-141B aircraft can carry 2 AH-64As, with moderate disassembly requiring 36 man-hours (covered in TM 55-1520-238-S).

(a) The following items must be removed

1) Air Data Sensor

2) Main Rotor Head and Blades

3) Upper Pylon Cowling

4) VHF #1 Antenna

5) VHF #2 Antenna

6) UHF Antenna

7) Stabilator

8) Pylons

9) Two Tail Rotor Blades

(b) The following items must be stowed

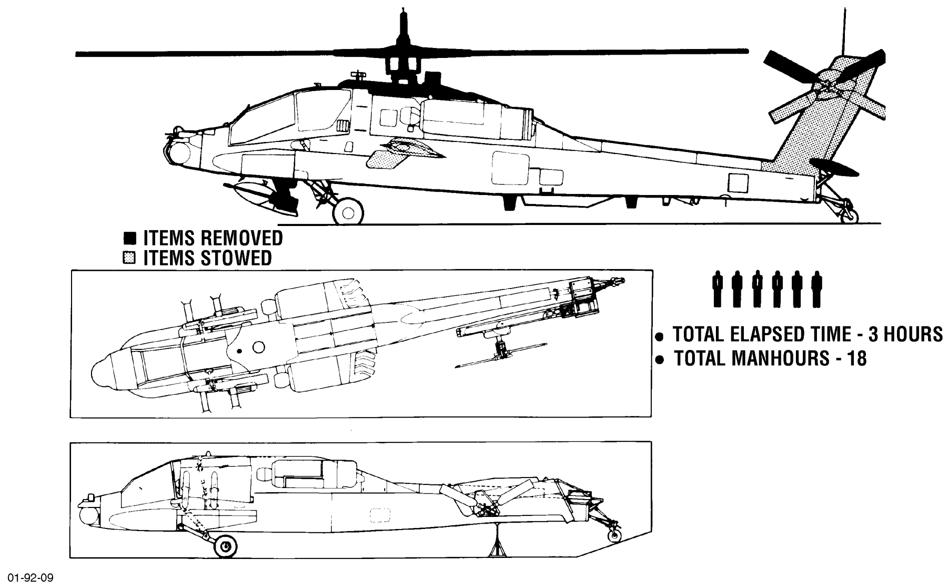
1) Chain Gun Assembly

2) Wings

3) Two Tail Rotor Blades

4) Vertical Stabilizer

AIR TRANSPORTABILITY - C-130



NOTES

(3) C-130 aircraft - can carry 1 AH-64A (not covered in TM 55-1520-238-S), with major disassembly.

2. Responsibilities

a. Responsibilities of cargo aircraft crews

(1) Loadmaster advises and supervises the helicopter loading, restraint requirements, and off-loading.

(2) The cargo aircraft loadmaster and crew members provide technical advice and assistance to the responsible Army loading team during helicopter loading, tiedown, and off-loading operations.

(3) In addition, crewmembers will

(a) Rig and operate all loading and off-loading aids that are part of the cargo aircraft.

(b) Designate on-board helicopter locations.

(c) Determine restraint requirements.

(d) Provide tiedown devices.

(e) Inspect and verify all tiedowns.

(f) Direct placement of shoring during loading.

(g) Direct kneeling and erecting operations.

(4) The cargo aircraft loadmaster will determine the cargo aircraft balance requirements.

b. Responsibilities of Army loading teams

(1) Prepare each helicopter for shipment.

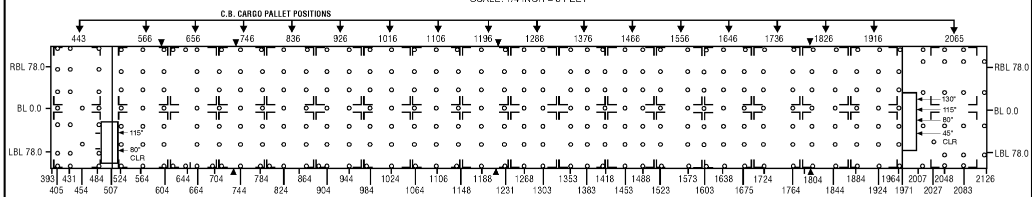
(2) Mark center of balance locations.

C-5A PASSENGER CARGO MANIFEST

1. UNIT BEING AIRLIFTED *(Name or Number)*	2. UNIT IDENTIFICATION CODE	3. TYPE MOVEMENT PLAN	4. MOVEMENT DATE	5. UNIT AIRCRAFT LOAD NO. OF	PAGE OF PAGES
6. MISSION NUMBER	7. AIRCRAFT SERIAL NO. *(Last five)*	8. CONFIGURATION	9. DEPARTURE AIRFIELD/ETD	10. DESTINATION AIRFIELD/ETA	

11. ACTUAL LOADOUT

SCALE: 1/4 INCH = 3 FEET



LOAD SEQUENCE a.	ITEM MODEL AND NOMENCLATURE/DESCRIPTION b.	VEHICLE PACKAGE NO. OR SERIAL INCREMENT NO. c.		d. REMARKS *(Special Handling, Shoring)*		e. PLANNED LOAD DATA						f. ACTUAL LOAD DATA				g. REMARKS CODES *(For use in Column d(1))*
				REMARKS CODE *(From col g)* (1)	OTHER (2)	TOTAL *(in inches)* LENGTH	WIDTH	HEIGHT	GROSS WEIGHT *(Total Pounds)*	FUSELAGE STATION	MOMENT *(100,000)*	HEIGHT *(Total Inches)*	GROSS WEIGHT *(Total Pounds)*	FUSELAGE STATION	MOMENT *(100,000)*	
																1. Off center: 1A. RIGHT 1B. LEFT
																2. Center line load.
																3. Shoring Required: 3A. PARKING 3B. ROLLING 3C. SLEEPER 3D. SPECIAL
																4. Must be positioned in direction of arrow.
																5. Sequence by actual weights 6. Hazardous Cargo: 6A. DD From 1387-2 6B. DD From 2133
																7. Maximum fuel: 7A. 1/2 TANK 7B. 1/4 TANK
																8. Equipment drained/purged: 8A. DRAINED *NOT* PURGED 8B. PURGED
12a. PASSENGER SEATS PLANNING DATA		13. TOTAL WEIGHT/MOMENT FROM REVERSE														9. Vent kit required. Other Conditions: Identify in column d(2).
NUMBER SEATS / AVG WEIGHT *(Pounds Each)* / TOTAL PLANNED WT.		14.		TOTAL						LOAD CG STA				LOAD CG STA		

12b. PASSENGER SEATS ACTUAL DATA		15a. PLANNING LOAD DATA CERTIFICATION	DATE CERTIFIED	14. TYPED/PRINTED NAME, GRADE, ORGANIZATION OF PLANNING OFFICIAL	SIGNATURE OF PLANNING OFFICIAL
NUMBER SEATS USED	TOTAL WEIGHT *(Pounds)*	15b. ACTUAL LOAD DATA CERTIFICATION	DATE CERTIFIED	14. TYPED/PRINTED NAME, GRADE, ORGANIZATION OF LOAD DATA VALIDATOR	SIGNATURE OF LOAD DATA VALIDATOR

DD Form 2130-1, DEC 88
02-94-19

Previous editions are obsolete.

C-5 A/B CARGO MANIFEST

NOTES

(a) Center of balance location will be marked on both sides of helicopter fuselage.

(b) The center of balance of each separately loaded major component (not stowed on or within a helicopter) will be marked on the component or package outer surface.

WARNING

Center of balance locations and shipping weights of helicopters must be accurately determined. Inaccurate balance locations or incorrect shipping weights will cause inaccurate cargo aircraft weight and balance computations, which will endanger cargo aircraft, crew members, and cargo.

(3) Weights of shipment-ready helicopters and separately loaded major components will be checked by the loading team. Helicopter fuselage will be tagged to indicate shipping weight. All weights will be recorded on manifest.

(4) A manifest (FM 55-12) will be prepared by the loading team. The weight, location, and center of gravity of each helicopter (as configured for shipment) and each separately loaded component will be itemized.

(5) The loading team will be prepared to demonstrate to the cargo aircraft commander, that all removed components are adequately packaged and restrained in accordance with the applicable Air Force -9 Series Technical Order.

(6) The loading team will submit a list of hazardous materials to the cargo aircraft commander. The list will itemize all hazardous or dangerous materials, as defined in TM 38-250, that will be shipped with or within helicopters.

(7) Furnish required shoring, ramps, loading and unloading aids, and auxiliary lighting that are not part of the cargo aircraft.

3. Equipment and facility requirements

a. Foul weather shelter

b. Fire fighting equipment

c. Grounding devices and adequate grounding locations

d. Clear operating area

4. Characteristics of shipment by vessel

   a. Helicopters may be flown to dockside or flight deck.

   b. Minimum disassembly is required.

   c. Allows the maximum number of helicopters to be deployed.

   d. Possible damage may result to top-side helicopters during gale-force winds or high seas.

   e. Vessel capacities vary with vessel and method of shipment (operationally ready or high density shipping method).

   f. Responsibilities of Military Traffic Management Command (MTMC) and Military Sealift Command (MSC)

      (1) Shipping arrangements - when contacted by the appropriate command, the MTMC commander will arrange with the MSC commander for vessel shipment of helicopters.

      (2) Center of balance identification - the MTMC will arrange for the shipping activity to mark the center of balance of each helicopter on the side of fuselage.

      (3) Loading and tiedown - the MTMC will make arrangements with a stevedore activity or commercial stevedore firm to load and tie down helicopters on the vessel. The MTMC and MSC will supervise all loading and tiedown procedures.

      (4) Preparation of loading plan and manifest - the MTMC, in coordination with the shipper, will prepare a loading plan and all required manifests.

   g. Responsibilities of shipper

      (1) Preparation for shipment - helicopter disassembly, component removal and stowage, cleaning, preservation, and packing will be accomplished by the shipper.

      (2) Coordination with MTMC - the shipper will furnish all data and information required to efficiently load the vessel, for example: weight and cube; fueled or unfueled condition of helicopters. In addition, the shipper will function as an advisor on loading and tiedown of helicopters.

h. Responsibilities of vessel crew

(1) En-route maintenance - designated maintenance escort personnel will conduct daily inspections of helicopter protective covering and will repair protective covering in accordance with appendix G of TM 55-1520-238-23.

(2) Tiedown security - security of loaded helicopters is the responsibility of the vessel commander. Tiedowns will be inspected daily and maintained in secure condition.

i. Equipment and facility requirements

(1) Foul-Weather Shelter

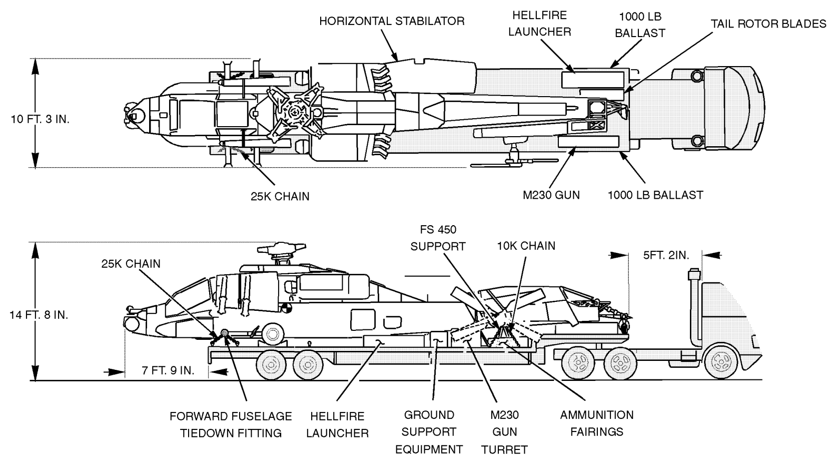
(2) Fire Protection

(3) Grounding devices and adequate grounding locations

(4) Clear operating area

(5) Seven-ton dockside crane

TRUCK TRANSPORTABILITY- FLAT BED



NOTES:
1. HELICOPTER TIEDOWN CHAIN STRENGTH INDICATED IN 1000 POUND (K) UNITS.
2. TRUCK CLEARANCES SHOWN TYPICAL FOR 40-FOOT TRAILER.

01-94-18
01-93-49

NOTES

5. Characteristics of shipment by truck

   a. Normally used for recovery of downed aircraft.

   b. Extensive disassembly of helicopter is required.

   c. Only one helicopter can be transported per vehicle.

   d. Possible additional damage may result during uploading, downloading, or road hazards.

   e. Transporter requirements - a commercial low boy trailer with air-ride suspension or a military M270Al trailer truck, both at least 40 feet in length with a minimum capacity of 20,000 pounds.

   f. Type of shipments

      (1) Tactical truck shipment - this is defined as a short haul shipment (not to exceed 100 miles, including helicopter recovery) by an Army M270A1 trailer truck. This type of shipment is intended to evacuate a disabled helicopter to a maintenance unit for repair or preparation for a different mode of transport.

      (2) Logistical Truck Shipment - this is defined as long haul (in excess of 100 miles) shipment by a standard commercial, 30 inch high, low boy, air ride suspension, semi-trailer. It is intended to evacuate a disabled helicopter to a major overhaul facility. Normally, truck transport of serviceable helicopters is not a primary mode recommended for use, however, it is permissible when transported in accordance with these procedures on an air-ride suspension tractor/trailer.

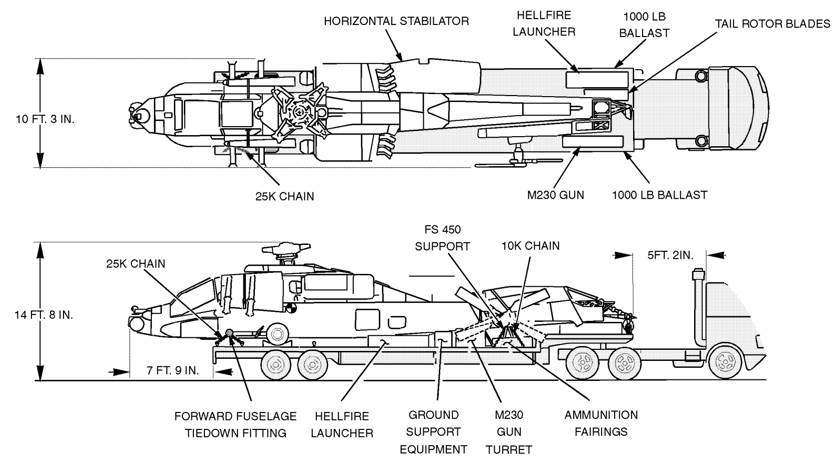
   g. Responsibilities

      (1) Responsibilities of MTMC - the supporting transportation officer (TO) will function as MTMC representative and coordinate data with MTMC as necessary.

         (a) Shipping arrangement - the TO will arrange for highway truck shipment of AH-64 helicopter. Required permits will be obtained for all overweight, overlength, and overheight loads.

         (b) Loading and tiedowns - the TO will designate a service activity or unit to load and tiedown the helicopter on the transport trailer in accordance with these procedures. TO personnel will supervise all loading and tiedown tasks.

TRUCK TRANSPORTABILITY-
FLAT BED



NOTES:
1. HELICOPTER TIEDOWN CHAIN STRENGTH INDICATED IN 1000 POUND (K) UNITS.
2. TRUCK CLEARANCES SHOWN TYPICAL FOR 40-FOOT TRAILER.

01-94-18
01-93-49

NOTES

(2) Responsibilities of shipper

(a) Coordinate movement - the shipper will coordinate all shipments through the supporting TO.

(b) Coordinate lifting device - the shipper will coordinate through command channels for a lifting device and operator to load helicopter on truck. Coordinate with receiving availability of device for unloading helicopter.

(c) Center of balance and weight identification - the shipper will mark accurate weight and balance of the helicopter on both sides of helicopter fuselage.

(d) Loading and tiedown - the shipper shall function as an advisor and assist in loading and tiedown of helicopter.

(e) Preparation for shipment - helicopter disassembly (component folding, removal, and stowage), cleaning, preservation, packaging, and installation of heat shrink protective covering will be accomplished by the shipper.

h. Equipment and materials - the shipper will provide all necessary materials and equipment to prepare and load helicopter on the trailer.

i. Rig helicopter - the shipper will rig helicopter for loading.

j. Equipment and facility requirements

(1) Foul weather shelter

(2) Fire fighting equipment

(3) Grounding devices and adequate grounding locations

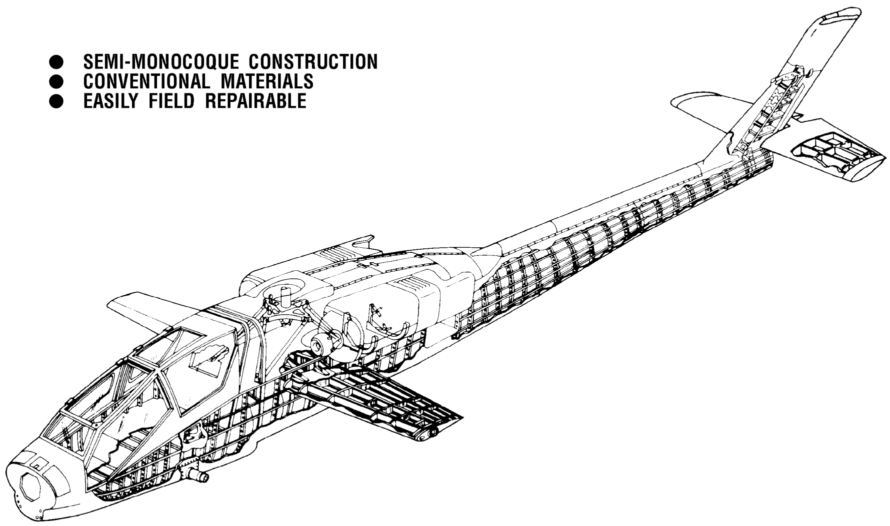
(4) Clear operating areas

(5) Appropriate lifting capability

6. Self-deployment - the AH-64A Attack helicopter is self-deployable with a ferry range of 1,000 nautical miles (1151 statute miles) against a 10-knot head wind, with a 20-minute fuel reserve.

AIRFRAME STRUCTURE

- SEMI-MONOCOQUE CONSTRUCTION
- CONVENTIONAL MATERIALS
- EASILY FIELD REPAIRABLE



02-93-04

NOTES

A. Airframe

1. The airframe provides mounting for the helicopter systems, equipment, and ordnance.

2. Provides a stable weapons delivery platform.

3. Provides protection for the aircrew and major components.

4. Airframe structure

a. Design features are incorporated to increase both aircraft and crew survivability.

b. The AH-64A airframe is a one-piece integral design.

c. The airframe has the strength to withstand compression, tension, torsion, and shearing force loads, exceeding the required design limits, throughout the entire flight envelope.

d. The fuselage is a semi-monocoque construction.

(1) Semi-monocoque construction greatly reduces the potential of catastrophic damage to the fuselage.

(2) Fuselage strength and rigidity is obtained through the structural members and the skin.

e. Conventional materials are used.

(1) Aluminum

(2) Composite materials

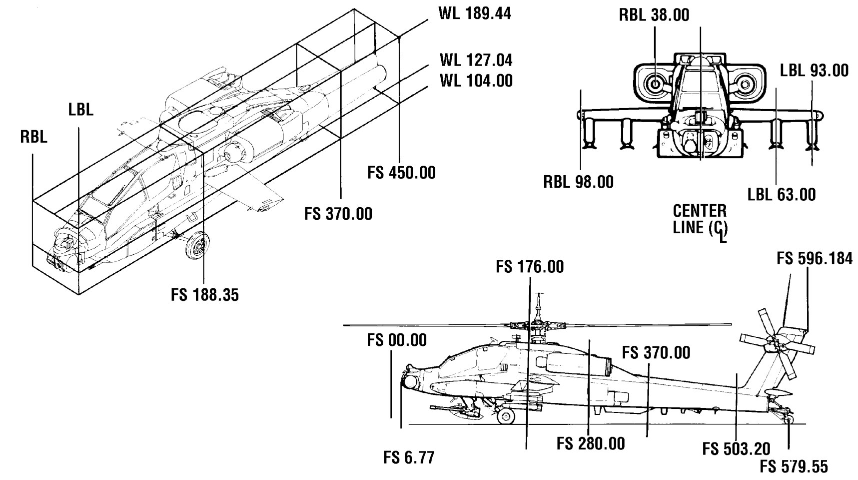
(a) Carbon/graphite

(b) Kevlar

(3) Titanium

f. Common uses of these materials, and their properties, will be covered in detail later in this lesson plan.

AIRFRAME STATION LOCATION



02-92-09

NOTES

5. Airframe station location

a. In order to locate points on the airframe, imaginary lines measured in inches indicate the following.

(1) Fuselage station (FS) - horizontal distance from the reference datum line (RDL).

(2) Butt line, left (LBL) or right (RBL) - distance and direction from the aircraft center line (CL).

(3) Water line (WL) - vertical distance from the horizontal reference line.

b. All access doors, covers, and fairings are identified by a letter(s) and a number(s) painted on the access.

(1) The letter(s) indicates general location and/or reference line used.

(2) The number(s) indicates number of inches from the applicable reference line.

c. Major airframe sections are grouped according to the following fuselage station references.

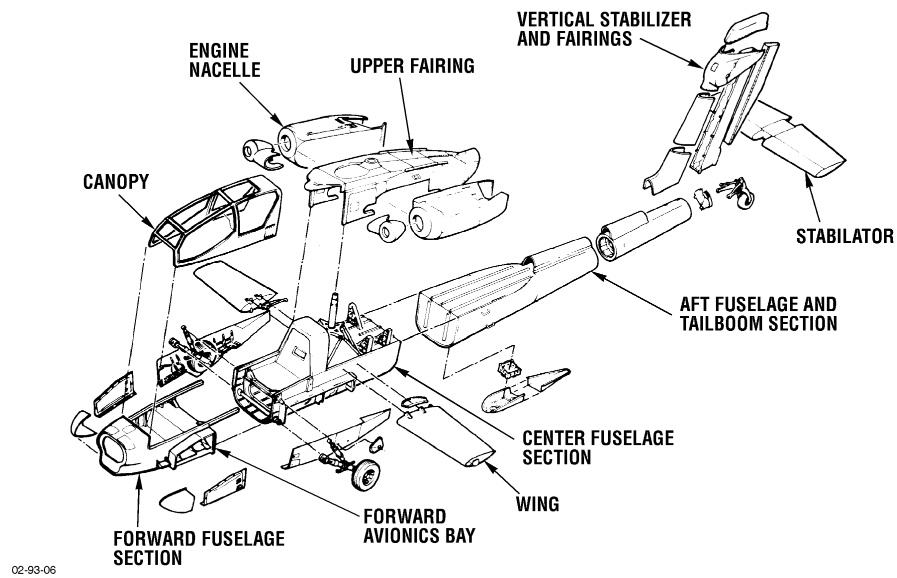
(1) Forward fuselage - FS 35.50 to FS 115.00

(2) Center fuselage - FS 115.00 to FS 280.00

(3) Aft fuselage - FS 280.00 to FS 450.00

(4) Tailboom - FS 450.00 to FS 547.15

MAJOR AIRFRAME SECTIONS



NOTES

6. Major airframe sections and subsections

   a. Forward fuselage section

      (1) Forward avionics bays (FABs) (left and right)

      (2) Canopy (the canopy section attaches to both the forward and center fuselage sections)

   b. Center fuselage section

      (1) Engine nacelles

      (2) Upper fairings

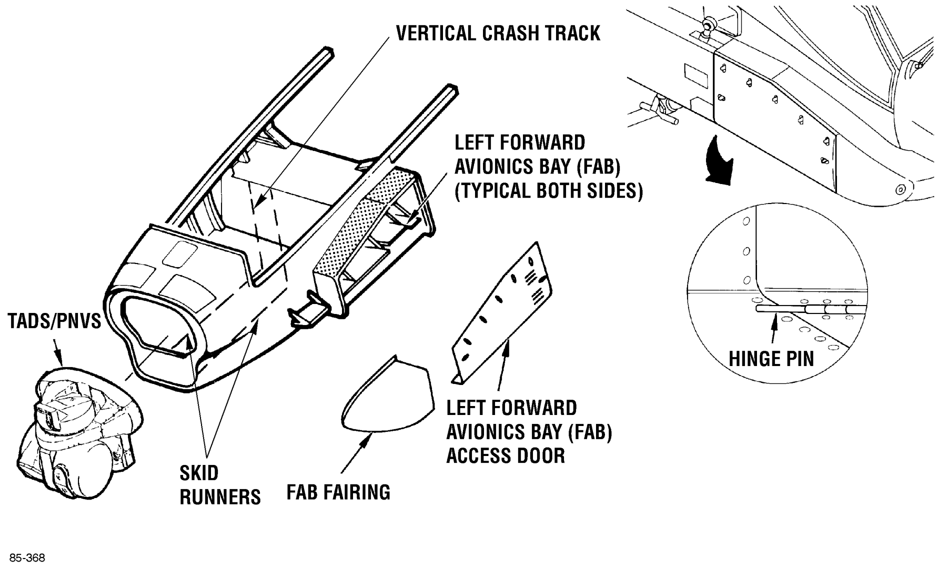
      (3) Wings

   c. Aft fuselage and tailboom section

      (1) Vertical stabilizer and fairings

      (2) Stabilator

FORWARD FUSELAGE SECTION



NOTES

7. Forward fuselage section

   a. Forms the copilot/gunner's (CPG's) crewstation

   b. Provides the structural integrity for mounting the

      (1) Target acquisition and designation sight/pilot's night vision sensor (TADS/PNVS)

      (2) Base support for the outside mounted avionics equipment (left and right FABs)

      (3) Area weapon system (AWS) turret and 30mm automatic cannon

   c. Consists of

      (1) A left and right FAB

      (2) The FAB provides mounting and environmental protection for a number of electronic line replaceable units (LRUs).

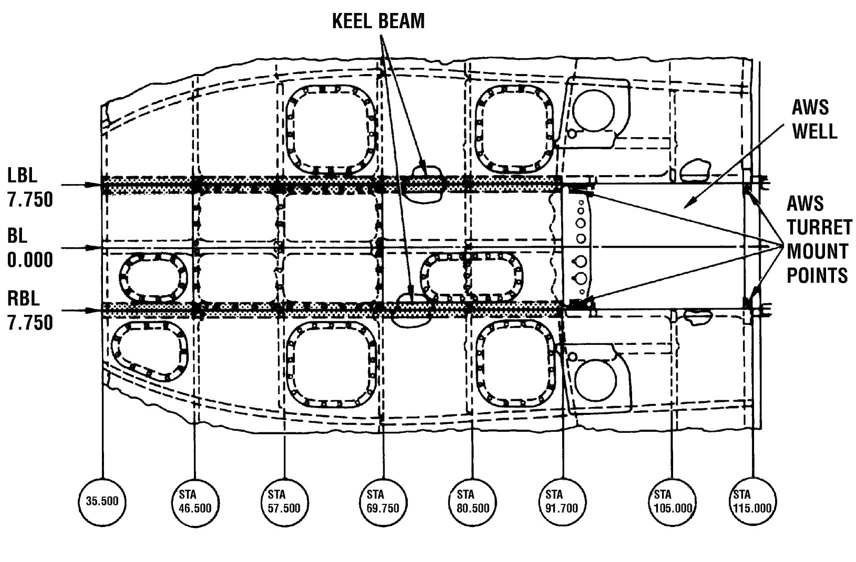
      (3) The forward portion consists of a single shelf. Below the shelf is a vaneaxial fan mounted to the airframe. It provides cooling air to the FAB. An aerodynamic fairing provides environmental protection for the compartment.

      (4) The FAB contains an upper and lower shelf. The top portion is an aluminum honeycomb structure which provides an access area for crewmembers or maintenance personnel. The surface area is coated with anti-skid material.

      (5) A very large access door with seven quick release thumb latches provides easy accessibility. The door is secured along the bottom of the FAB using a piano-type hinge set-up.

      (6) A swing-out step is installed under the right side FAB. This step has experienced some cracking in the field. Implementation of MWO 1-1520-238-50-03 modification of attack helicopter AH-64A (NSN 1520-01-10-9519) right hand FAB step support corrects this problem. Effective date 1 June 90 and completion date 31 May 94.

FORWARD FUSELAGE BOTTOM VIEW



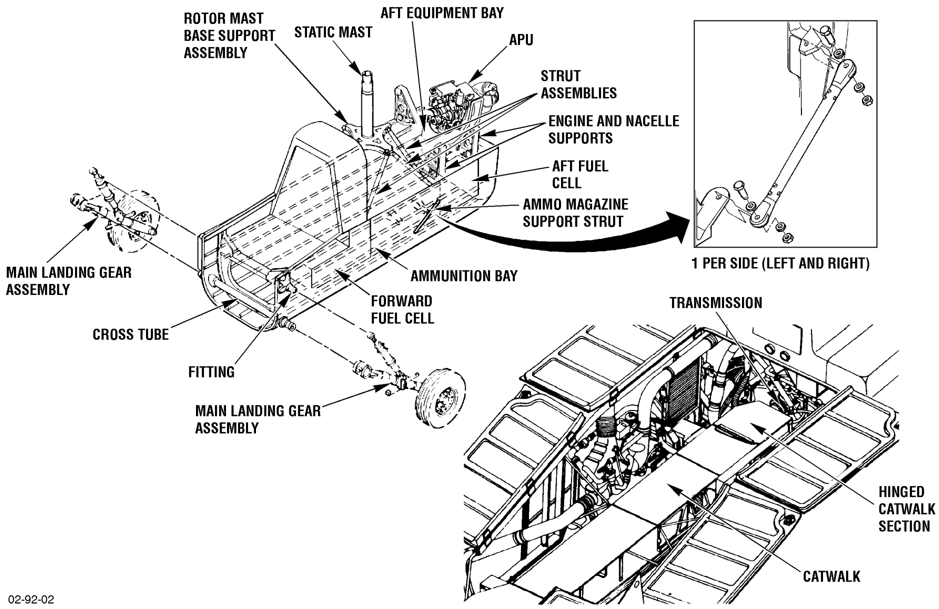
NOTES

8. Forward fuselage, bottom view

   a. Two longitudinal aluminum skid runners (keel beams), integral with the bottom portion of forward fuselage, resist fuselage deformation in the event of a high-impact landing. The beams extend from FS 35.500 to 91.700. Laterally they are positioned at LBL 7.750 and RBL 7.750.

   b. The AWS turret is mounted to the vertical crash track. The track guides the turret and weapon up into the well area to prevent it rupturing the forward fuel cell in a high-impact landing situation.

CENTER FUSELAGE SECTION



NOTES

9. Center fuselage section

   a. Forms the pilot crewstation and a major portion of the aft equipment bay.

   b. Provides mounting for

      (1) Main landing gear assemblies - attach to the crosstube, with the upper end of the shock strut being attached to the fitting assembly.

      (2) Forward and aft fuel cell enclosure and support

      (3) Ammunition bay

      (4) Engine and nacelle supports

      (5) Static mast

      (6) Rotor mast base support assembly

      (7) Strut assemblies (8)

      (8) Wings

      (9) Auxiliary power unit (APU)

   c. The center fuselage section is the primary support structure of the airframe.

   d. A fitting is attached to the left and right side of the fuselage at FS 120.00 and WL 134.00. The fitting provides mounting point for the main landing gear (MLG) shock strut.

   e. Provisions for installing a crosstube are located directly below the fittings at WL 108.50. The crosstube is installed through the fuselage and the tube supports the MLG.

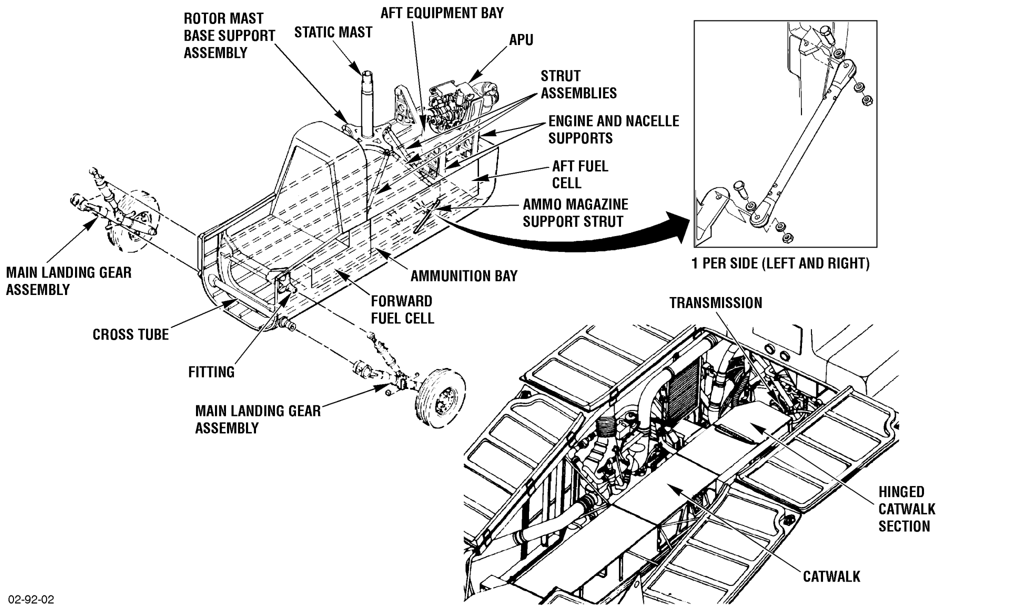
   f. The upright structure directly behind the area where the pilot seat is installed forms the electrical power distribution center. It contains electrical interface components (i.e. relays, contactors, control units). An access panel separates the compartment from the pilot's crewstation.

   g. Rigid foam is installed between the frames that support the fuel cells. Provides added structural integrity and keeps the fuel cells from sagging between the frames.

   h. A forward and aft aluminum alloy engine nacelle support assembly is attached to the deck of the aft equipment deck on both sides of the fuselage.

   i. An ammunition magazine support strut is installed on the left and right sides of the fuselage and is interconnected between FS frame 214.5 and FS frame 230.00.

CENTER FUSELAGE SECTION



NOTES

j. The static mast is mounted to the rotor support mast base assembly and contains the main rotor assembly and static mast.

k. A rotor support mast base assembly provides the mounting for the main transmission and supports the main rotor assembly and static mast.

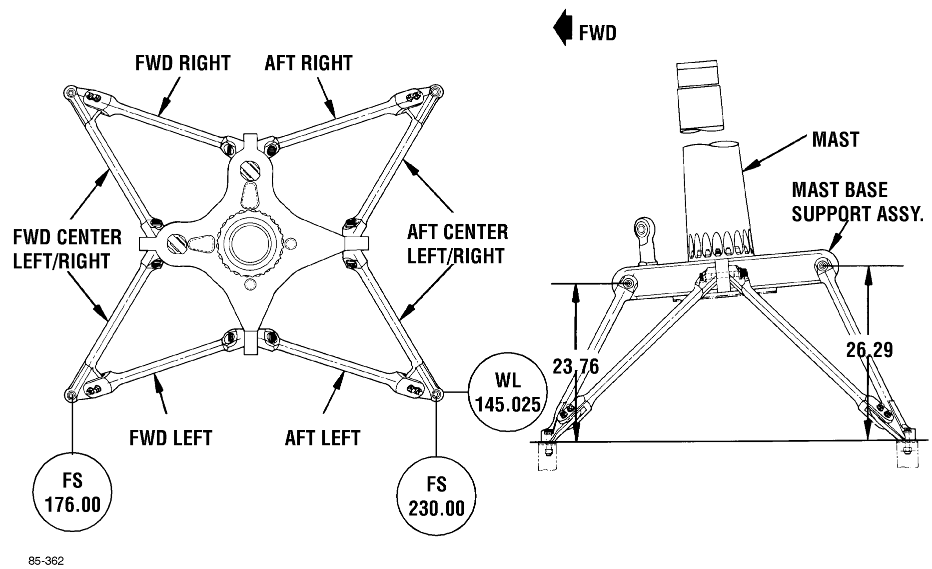
l. The strut assemblies (8) attach the rotor support mast base assembly to the center fuselage and support the main transmission rotor support base assembly, static mast, and main rotor assembly.

m. The center fuselage section transfers the flight loads from the main rotor system through the static mast, rotor support mast base assembly, and strut assemblies. This configuration reduces stress on the main transmission.

n. The aft equipment bay begins directly behind the transmission, at approximately FS 220.50, and extends into the aft fuselage.

o. A catwalk assembly is installed the length of the aft equipment bay. It consists of four aluminum bonded honeycomb panels mounted on several stand-off structures, approximately 12 inches off the deck. This provides a means of accessing the aft equipment bay without damage to the components. The surface of the catwalk panels are coated with an anti-skid material.

STRUT ASSEMBLIES



NOTES

10. Strut assemblies

a. Eight struts attach the rotor support mast base assembly to the fuselage and support the main transmission, static mast, and main rotor system.

b. The struts are

(1) Constructed of aluminum alloy.

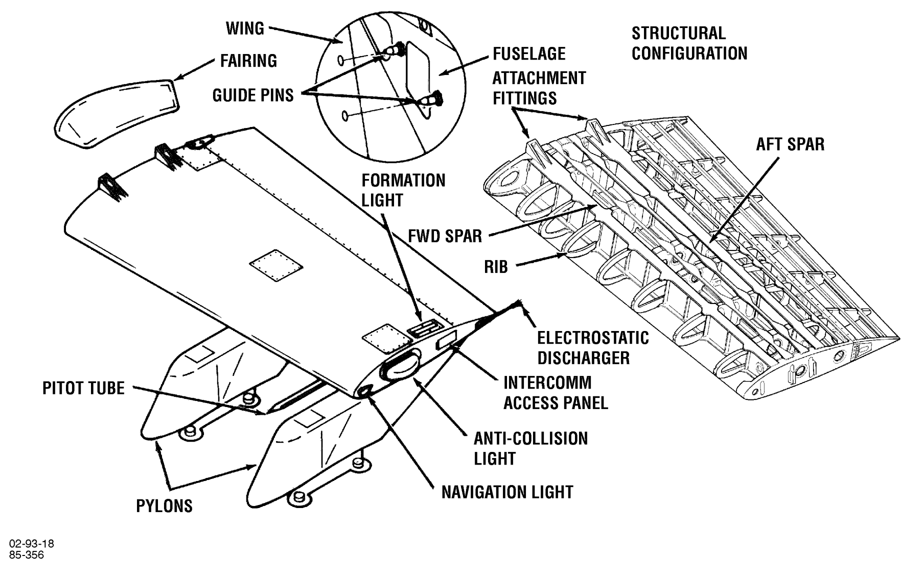
(2) Not interchangeable.

(3) Attached to the mast base support assembly at the upper end and to the transmission deck at FS 176.00, FS 230.00, and WL 145.02 at the lower end.

c. The strut mounting provides a 5E forward tilt of the mast base and static mast. This reduces the amount of forward cyclic displacement in order to obtain higher forward airspeeds.

d. The center fuselage section transmits the flight loads from the main rotor system through the static mast, rotor support mast base assembly, and strut assemblies. This configuration reduces stress on the main transmission and increases its life.

WING


WING
FAIRING
GUIDE PINS
FUSELAGE
ATTACHMENT
FITTINGS
STRUCTURAL
CONFIGURATION
AFT SPAR
FORMATION
LIGHT
FWD SPAR
RIB
ELECTROSTATIC
DISCHARGER
INTERCOMM
ACCESS PANEL
PITOT TUBE
ANTI-COLLISION
LIGHT
NAVIGATION LIGHT
PYLONS
02-93-18
85-356

NOTES

11. Wings

a. The wings provide mounting points for

(1) Two pylons per wing.

(2) Navigation lights (green on the right wing, red on the left wing).

(3) Anti-collision lights (red and white strobe).

(4) External intercommunications system (ICS) receptacle (one each wing).

(5) Formation light (green electroluminescent, one per wing).

(6) Pitot tubes and pitot static drains (CPG's on the left wing, pilot's on the right wing).

b. Provides a work platform/accessing area which is coated with an anti-skid material.

c. The wing is constructed of several aluminum alloy structural members, with aluminum skin.

d. Two pylons are mounted to each wing, with four captive bolts per pylon. No manual hydraulic or electrical disconnections are necessary. It is done automatically during removal. To facilitate installation, there are two alignment pins per pylon.

e. The pylons provide for the mounting of missile launchers, rocket pods, or auxiliary fuel tanks.

f. Each wing is mounted to the center fuselage section by four bolts, allowing quick removal and installation. To facilitate installation, there are two holes in the root end portion that align with corrosion-resistant steel pins attached to the fuselage at FS 199.75 and FS 214.500 at WL 139.00.

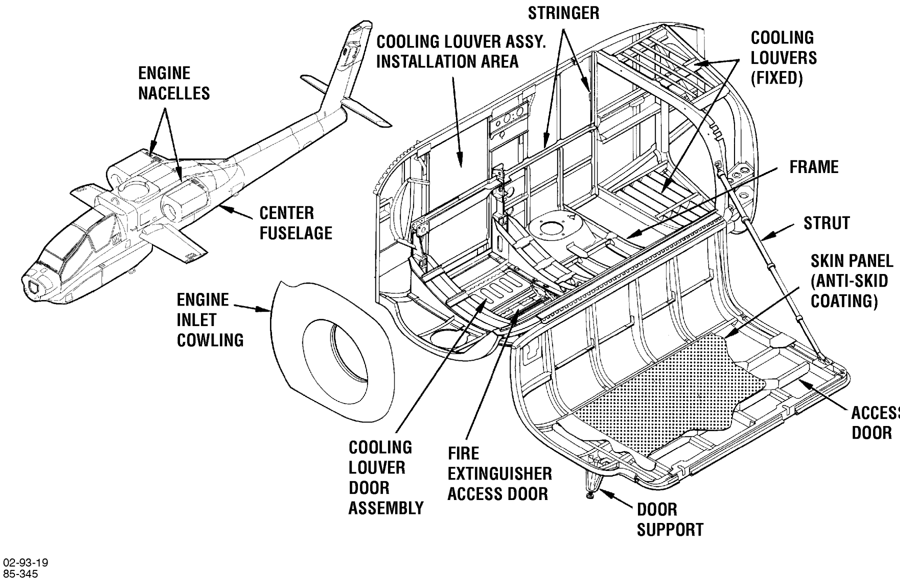
g. Electrical and hydraulic disconnects are located under an access panel on top of the wing.

h. Auxiliary tank fuel lines and connectors are located inside the trailing edge of each wing, if the extended range fuel kit is installed.

i. Each wing assembly contains an upper and lower aerodynamic Kevlar fairing that covers the mount fittings. The trailing edge portion is removable.

j. Each wing assembly contains an electrostatic discharger, located on the outboard trailing edge portion, for dissipating static electricity.

ENGINE NACELLES



NOTES

12. Engine nacelles and upper fairings

a. The upper fairings and engine nacelles are aerodynamically designed covers and structures used to protect helicopter systems and components from the environment.

(1) Provide access to the engines, nose gearboxes, transmission area, and aft equipment bay.

(2) Provide structural support for the GE 701 and 701C engines.

(3) Provide engine/airframe interface and protect the engines from the elements.

b. Attached at BL 23.75 and WL 164.00 of the center fuselage section by several bolts. The actual nacelle extends from FS 219.81 to approximately FS 280.00.

c. Constructed of several frames, stringers, and skin panels. The majority of the nacelle structure is made from aluminum alloy. The aft inboard mount point and stringer are constructed from titanium. The firewall is also titanium alloy. The skin is aluminum alloy (ALCLAD).

d. The cowling is V-band clamped to the inlet section of the engine. This is not an integral part of the nacelle.

13. Aluminum alloy engine inlets

a. A cooling louver door assembly is located at the bottom of the nacelle at BL 38.00, from FS 230.00 to FS 247.71. The door louvers use 5th stage bleed air to close, and are spring-loaded open.

b. A spring-loaded closed, hinged (fire extinguisher) access door is located at approximately BL 48.14 from FS 230.00 to FS 247.71.

c. Cooling louvers are installed into the fire wall from FS 230.00 to FS 247.71. They provide cooling airflow to the engine and a means for isolating the nacelle in the event of fire.

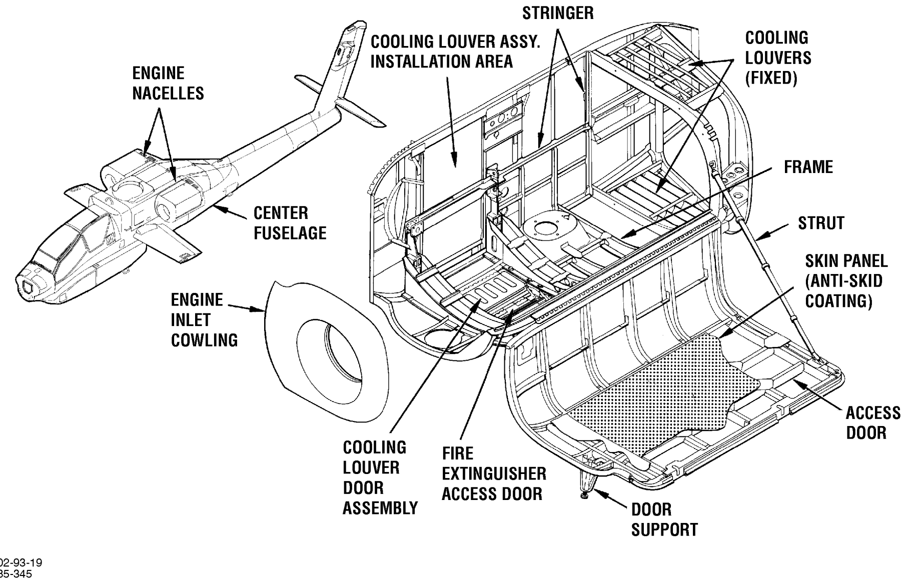
d. Integral, fixed louvers are located on the top and bottom of the aft section. They provide additional cooling air for the infrared (IR) suppression system.

e. The nacelle access door, when opened, becomes a work platform capable of supporting 400 pounds. The platform is coated with an anti-skid material.

(1) Engine nacelles are constructed of aluminum alloy and titanium.

(2) The nacelle door is supported by a telescoping strut at the aft end.

ENGINE NACELLES



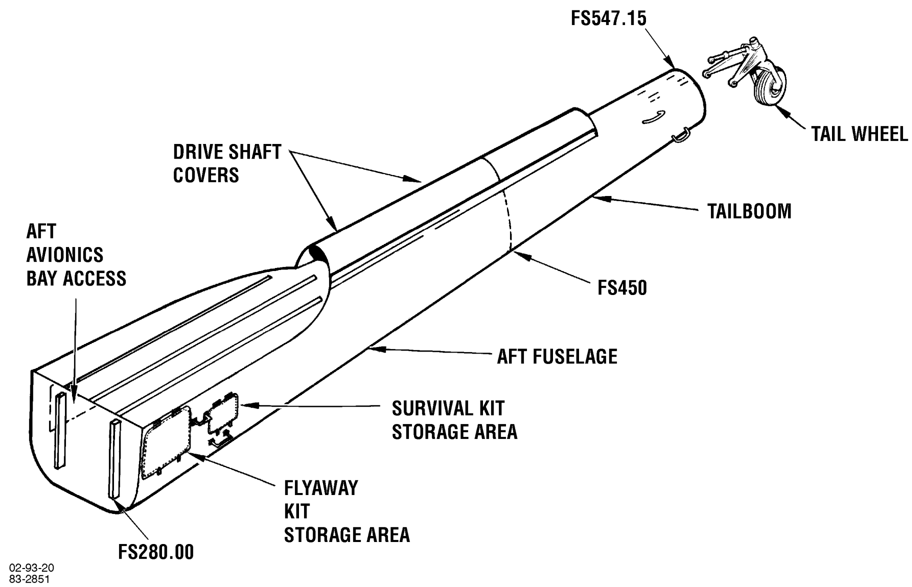
NOTES

(3) Attached to the forward portion of the door (outboard) is an adjustable support assembly. It supports the door at the wing assembly.

(4) The doghouse fairing provides a work platform to facilitate maintenance on the main rotor head assembly. The surface area is coated with an anti-skid finish.

(5) A formation light is mounted just aft of the aft equipment bay access door.

AFT FUSELAGE AND TAILBOOM SECTION



NOTES

14. Aft fuselage and tailboom section

a. The aft fuselage and tailboom section provide mounting for

(1) Utility hydraulic manifold

(2) Tail rotor drive shafts 4 and 5

(3) Tail landing gear (TLG)

(4) Vertical stabilizer

b. The aft fuselage starts at FS 280.0 and ends at FS 450.0. The latter portion of the aft equipment bay is encompassed in the aft fuselage, with the catwalk extending to the beginning of the tail rotor drive shaft cover.

c. The aft avionics bay is accessible from the right side of the fuselage. It extends from FS 280.00 to FS 310.00.

d. Flyaway kit storage area is accessible from the left side of the fuselage. The storage area extends from FS 280.00 to 310.00 and can be loaded to 15 pounds per square foot with a capacity of 60 pounds. The floor area is approximately 7.9 square feet and the volume is approximately 21 cubic feet. Floor tie down fittings are attached to the deck.

e. The survival kit bay is accessible from either side, extending from FS 310.00 to FS 340.00, and it can be loaded to 15 pounds per square foot with a capacity of 100 pounds. The floor area is approximately 7.3 square feet and the volume is approximately 17 cubic feet. Floor tie-down fittings are attached to the deck.

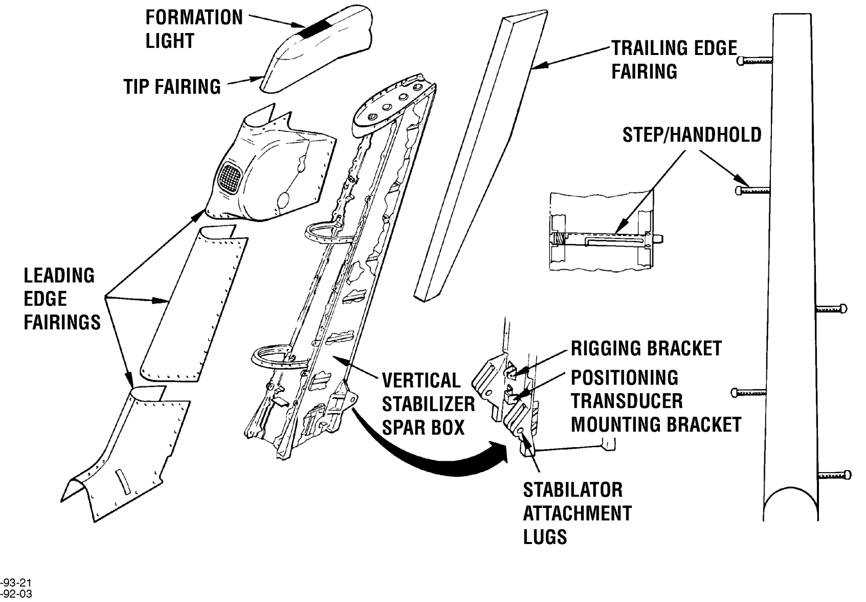
f. Drive shaft covers are hinged with quick-release fasteners installed on the right side to allow quick access to the tail rotor drive components.

g. A splice joint extends from FS 436.50 to FS 476.60. This is the manufacturer's break point. The splice supports the break point and carries the stresses.

h. The tail boom section extends from FS 450.00 to FS 547.15.

i. Steps are mounted on the left side of aft fuselage and tailboom section for accessing the aft equipment bay and the vertical stabilizer.

VERTICAL STABILIZER



NOTES

15. Vertical stabilizer (empennage)

a. Provides directional stability for helicopter during forward flight.

b. Provides mounting for

(1) Intermediate gearbox (IGB)

(2) Tail rotor drive shaft No. 6

(3) Tail rotor gearbox (TRG)

(4) Stabilator

c. Attached by bolts to the tailboom at FS 531.04 and FS 547.15 (2 bolts at each station.)

d. Constructed of aluminum alloy - the major structure of the stabilizer is the spar box.

e. Five step/handhold assemblies are supported by the spar box. The assemblies permit personnel to access the vertical stabilizer.

f. Contains three leading edge fairings that are attached using quick-release fasteners for easy access.

(1) The lower leading edge fairing is a two-piece configuration and has slots on both sides for cooling purposes.

(2) The center leading edge fairing is a one-piece design.

(3) The upper leading edge fairing is a two-piece design with an opening that has a wire mesh screen. This opening allows ram air to enter for cooling purposes and the screen keeps foreign debris from entering.

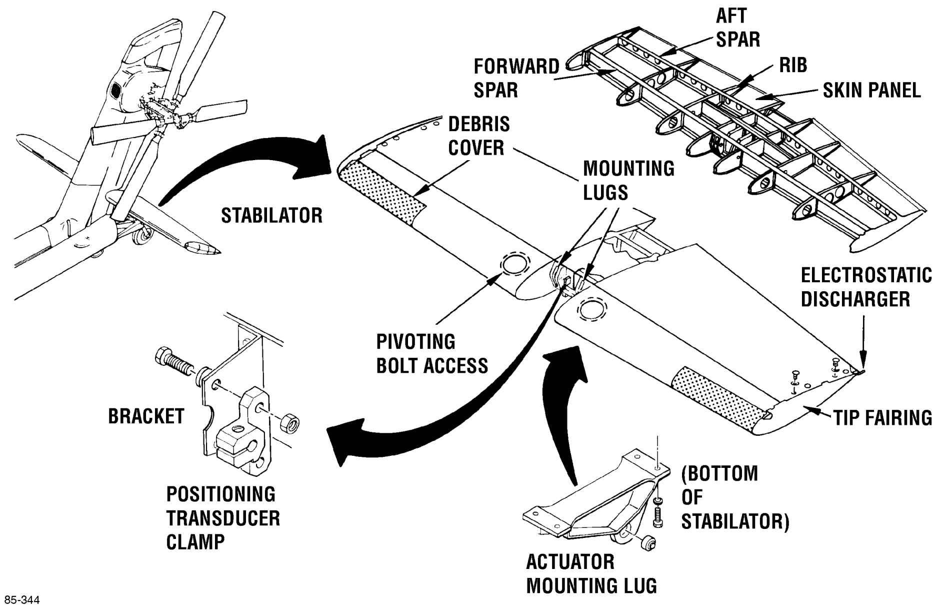
(4) The vertical stabilizer tip fairing provides mounting for a formation light, navigation light, and two radar warning antennas.

(5) The trailing edge fairing contains an integral VHF antenna and FM-AM No. 1 pilot communication antenna. The fairing forms the curvature of the vertical stabilizer.

g. Two integral mounting lugs are located at the base of the spar box assembly, aft portion. They provide mounting for the stabilator assembly.

h. An electronic positioning transducer is mounted to a bracket riveted to the lower aft portion of the stabilizer between the stabilator attachment lugs.

STABILATOR



NOTES

16. Stabilator

a. Improves handling characteristics of the helicopter and enhances the forward field of view.

b. Attached to the lower portion of the vertical stabilizer on the empennage. Two pivoting lugs, integral with the stabilator, mate with two lugs at the vertical stabilizer and are secured by two pivoting bolts.

c. A symmetrical airfoil that is swept and tapered.

d. Constructed of aluminum alloy.

e. A polyurethane debris sheet is bonded to a portion of the left and right side leading edge and bottom surface of the stabilator. This debris cover is 0.050 inch x 26.0 inch x 38.0 inch and protects the skin from debris expelled from the missiles and rockets during firing.

f. There is an electrostatic discharger attached to the trailing edge, right and left sides, at approximately BL 64.00. These electrostatic dischargers dissipate static electricity.

g. The tip fairing assemblies are made of Kevlar material and are removable.

h. An electronic positioning transducer clamp is mounted to a bracket riveted to the stabilator between the pivoting lugs. It provides positioning signals to the crewmember's stabilator positioning indicator.

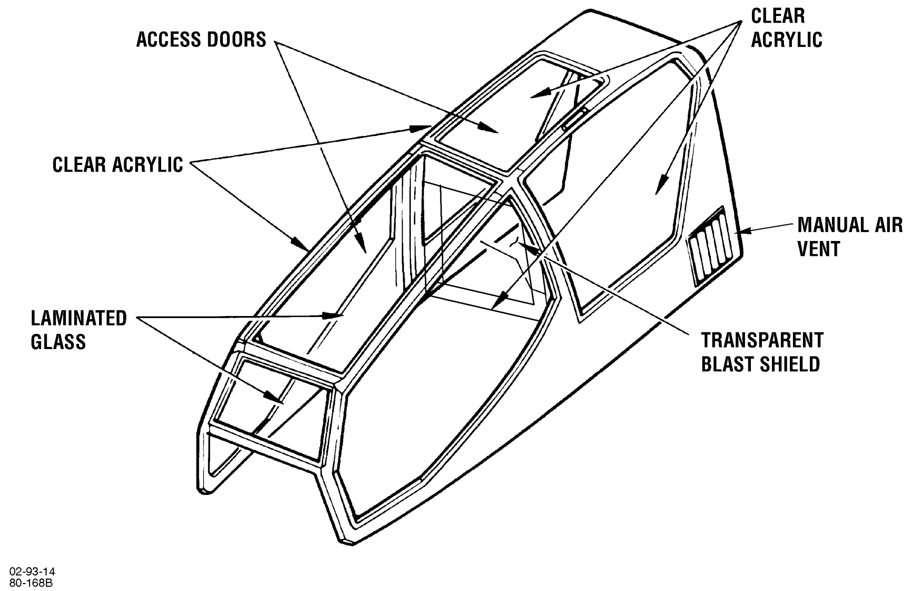
i. A single mounting lug is attached to the lower portion of the stabilator to provide mounting for the stabilator control actuator.

j. Two pivoting bolt access panels are located at the bottom of the stabilator.

k. Normal stabilator operation is automatic with the relative position a function of longitudinal airspeed as measured by the air data system (ADS) in the speed range of 30-58 knots (34.5-68 mph) and by two independent pneumatic airspeed transducers at speeds above 58 knots (68 mph).

17. Inspection of the airframe is in accordance with TM 55-1520-238-23-2.

CANOPY



NOTES

A. Canopy

1. Provides the aircrew with

a. Protection from outside environment and wind blast.

b. An enclosure for a controlled environment.

c. Aids in crew protection in case of an aircraft rollover.

2. Canopy is supported by and mounted to the forward and center fuselage sections. It is attached at FS 57.50 and extends to FS 158.67.

3. Canopy consists of

a. Five laminated stretched acrylic panels

(1) Four side panels

(2) Aft upper canopy panel

b. Two laminated glass windshields

(1) Made of two sections of heat treated glass laminated with a thin layer of soft acrylic, providing the shatterproof capability.

(2) Lamination includes heating elements that afford the windshields with anti-ice capability.

c. Crewstation access is on the right side of the aircraft.

d. Transparent blast shield

(1) Upper transparent portion made of stretched acrylic, lower section made of Kevlar and boron carbide. (approximately 1.1 inches thick)

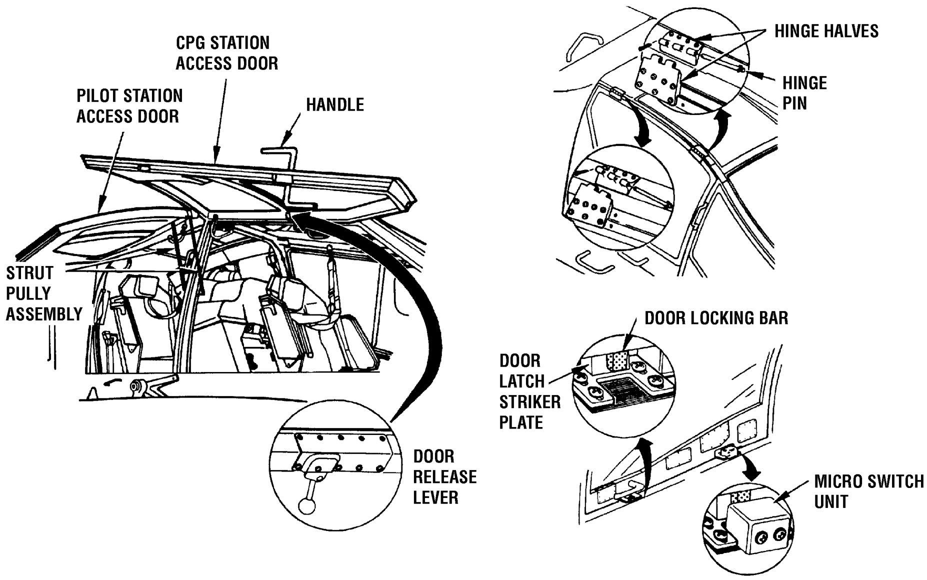
(2) Prevents incapacitation of both crewmembers by a single 23mm high explosive incendiary (HEI) hit.

(3) Provides protection for the aircrew in case of rollover by adding its support to the upper canopy area.

(4) Provides protection to the aircrew from rotor blade intrusion into the crewstations in case of a high-impact landing.

e. A manually operated air vent provides cooling air to the crewstations and FABs in the event of an environmental control unit (ENCU) failure.

CREW STATION ACCESS DOORS



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NOTES

4. Crewstation access doors

   a. Attached to the right side of the canopy via two non-adjustable hinge/pin assemblies.

   b. A strut pulley assembly provides support for the doors in the open position. The doors are capable of being held open in two different positions.

   c. The doors contain two locking bars which interface with the adjustable door latch striker plates. The doors contain a positive locking indication in the form of a micro-switch.

   d. A micro-switch is installed at the aft door latch striker plate of each door and will illuminate an amber canopy light on the pilot's caution/warning/advisory (C/W/A) panel if the doors are not properly closed.

   e. There are two ways of releasing the door from the open position. The handle at the forward locking bar or the small lever at the top of door frame. Due to the size of the doors, the crewmembers, once seated, are not able to reach the handle. The lever at the top of the door frame allows the crewmember to release the door while seated.

   f. The door mechanism consists of turnbuckles, cables, pulley brackets, support pins, bushings, push rods, springs, guides, and locking bars. All of these components are accessible from the inside of the door frame. The CPG's door has five access panels and the pilot's has four.

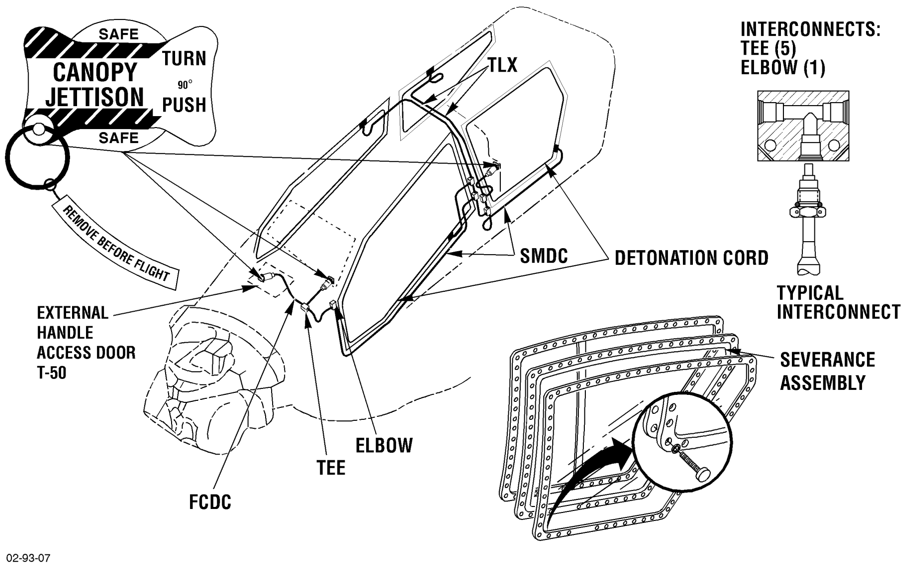
   g. A door lock is provided for security of each crewstation.

      (1) To provide for increased security of individual aircraft, MWO 1-1520-238-50-02 Modification of AH-64A Helicopter NSN 1520-01-106-9519 to re-key canopy door locks has been applied.

      (2) The following installed item was modified: Lock, Door Canopy NSN 5340-01-181-3991 Part Number 7-311112087.

      (3) Effective date for MWO 1-1520-238-50-02 was 19 August 89 and completion date of 18 August 93.

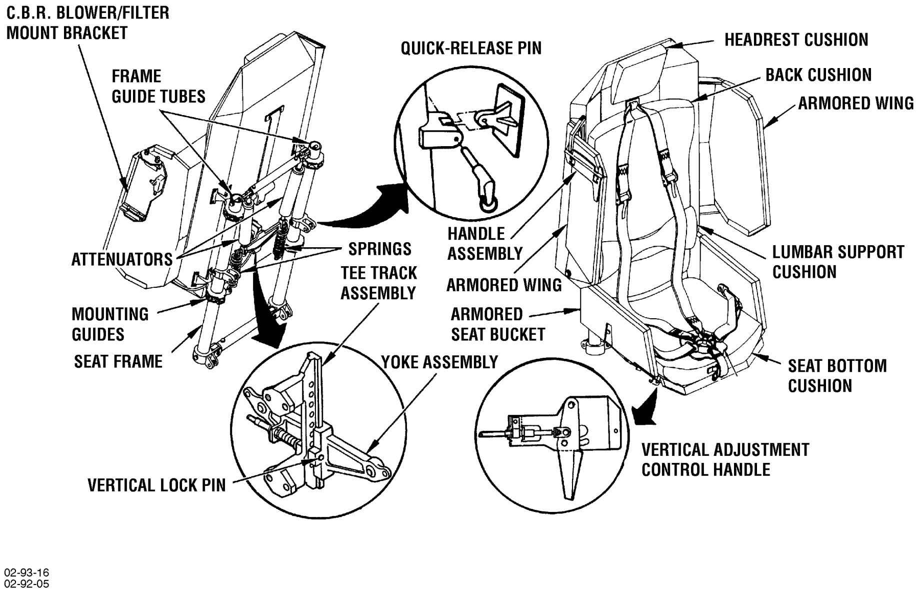
CANOPY JETTISON SYSTEM



NOTES

5. Canopy jettison system

CREW SEAT DESCRIPTION



NOTES

6. Crew seat description

   a. The crew seat provides

      (1) Seating for crewmembers.

      (2) Protection during a high-impact landing.

      (3) Ballistic protection against 12.7mm armor piercing incendiary (API) (exclusive of the chest area and the body's forward hemisphere).

   b. CPG and pilot seats are inter-changeable.

   c. Each armored seat weighs approximately 139.0 pounds.

   d. Armored seat and side panels are constructed of 15-ply Kevlar and ceramic tile (boron carbide). Also, woven nylon is used to prevent shattering when hit by a projectile.

   e. Four quick-release pins provide mounting of the seat to the canted bulkhead in each crewstation and permit seat removal without the use of hand tools. Four housing assemblies which contain replaceable bearings are installed to the bulkhead.

   f. There are two armored wing panels on each seat. The right side wing panel can be slid aft to enhance the ingress and egress of the crewstations. In order to slide the wing panel aft, the handle assembly is pushed in and slid rearward.

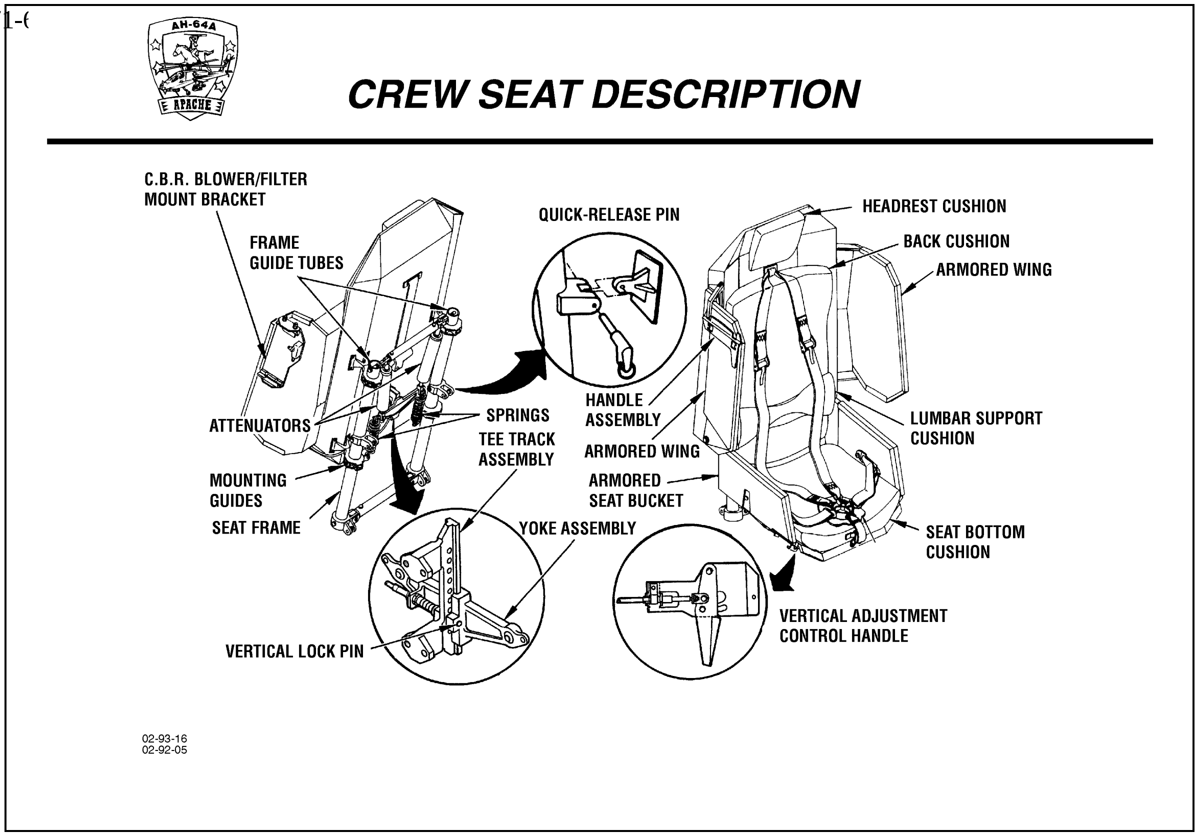
   g. The armored seat is attached to the frame guide tube via the mounting guides. The seat moves up and down on the guide tubes.

   h. Seat is adjustable in the vertical axis only. Seat adjustment is accomplished by pulling out on the vertical adjustment control handle, located on the lower forward right side of the seat.

   i. The vertical adjustment control handle is spring-loaded to the lock position. The handle is connected to a vertical lock pin by a cable assembly. The pin is attached to the yoke assembly.

   j. Two expansion springs provide the upward preload.

   k. There are two attenuators (shock absorbing) attached to the seat frame and seat. During a hard landing, the seat is forced downward. The spring-loaded pistons of the attenuators are pulled down. This action absorbs the impact energy.


AH-64A
APACHE
CREW SEAT DESCRIPTION
C.B.R. BLOWER/FILTER MOUNT BRACKET
FRAME GUIDE TUBES
QUICK-RELEASE PIN
HEADREST CUSHION
BACK CUSHION
ARMORED WING
ATTENUATORS
SPRINGS
TEE TRACK ASSEMBLY
HANDLE ASSEMBLY
ARMORED WING
LUMBAR SUPPORT CUSHION
MOUNTING GUIDES
ARMORED SEAT BUCKET
SEAT FRAME
YOKE ASSEMBLY
SEAT BOTTOM CUSHION
VERTICAL ADJUSTMENT CONTROL HANDLE
VERTICAL LOCK PIN
02-93-16
02-92-05

NOTES

WARNING

There is an upward spring preload on the seats at all times. The seat must be occupied whenever it is adjusted. If the seat vertical control handle is pulled when the seat is unoccupied, the seat will snap to the full up-position. This could cause severe personal injury. If injury occurs, seek medical aid.

l. Armored seat is equipped with four cushions which are attached by velcro fasteners

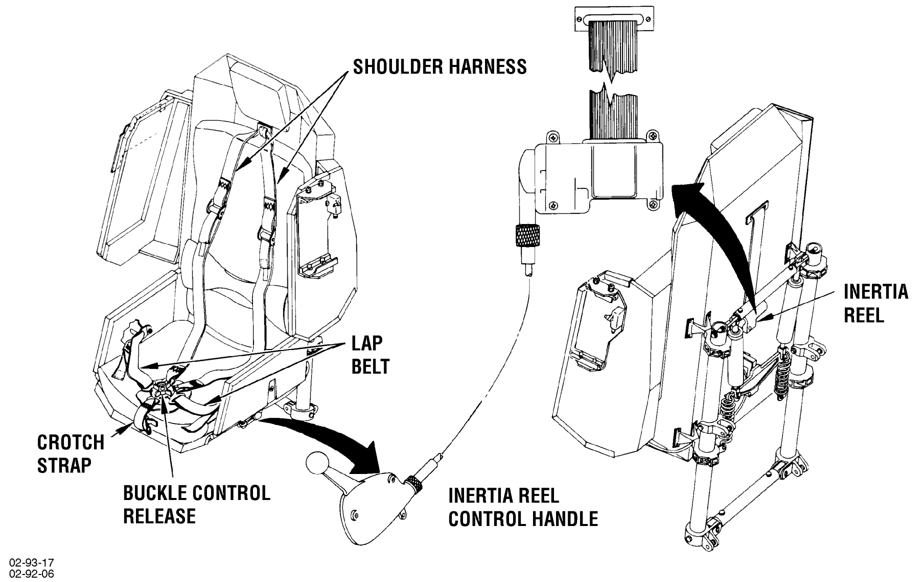
(1) Headrest cushion

(2) Back cushion

(3) Lumbar support cushion

(4) Bottom cushion

CREW SEAT RESTRAINT SYSTEM



NOTES

7. Crew seat restraint system consists of

   a. Shoulder harness

   b. Lap belt

   c. Crotch strap

   d. Buckle control release

   e. Inertia reel and control handle

      (1) Shoulder harness is locked either manually or automatically.

      (2) Inertia reel is mounted to the center of the back portion of the seat and is spring-loaded to rewind in either manual or automatic position.

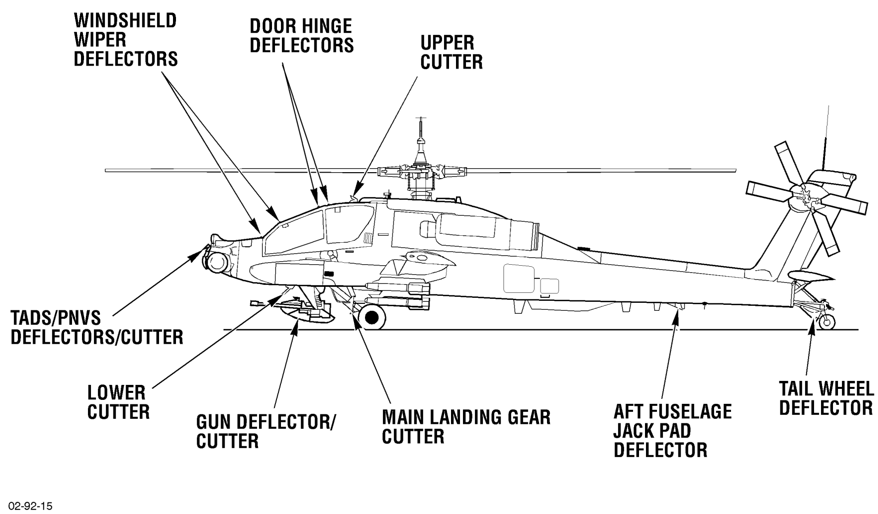
      (3) A force of 1.5 to 2.0 g's against the shoulder harness will lock the inertial reel automatically.

      (4) Forward (manual-lock) position stops forward movement of the shoulder harness.

      (5) When the inertia reel locks automatically, move control handle to the forward position and then to the aft position to release the lock.

8. Inspection of the canopy, canopy jettison system, crewstation access doors, and crew seat components is in accordance with TM 55-1520-238-23-2.

WIRE STRIKE PROTECTION SYSTEM (WSPS)



NOTES

A. Aircraft wire strike protection system (WSPS)

1. Enhances aircraft survivability by providing a means of deflecting and/or cutting electrical transmission and communication wires that may be encountered during nap-of-earth flight operations.

2. Installed on the following major assemblies

   a. TADS/PNVS

   b. M230 chain gun

   c. Landing gear (main and tail)

   d. Fuselage

3. A rigid, lightweight, passive system incorporating multiple components.

4. Capable of functioning during multiple wire strike encounters.

5. Prevents wires from hitting the aircraft between

   a. The landing gear tires and the fuselage.

   b. The fuselage and main rotor assembly.

6. The upper and lower components are capable of deflecting and/or severing a 0.375 inch diameter steel cable.

7. The upper components are capable of deflecting and/or severing two 0.419 inch diameter copper high-voltage wires, while the lower deflector/cutter assemblies can simultaneously deflect and/or sever a 0.375 inch diameter steel cable.

8. Major WSPS components

   a. TADS/PNVS deflectors and cutter assembly

   b. Windshield wiper deflectors (2)

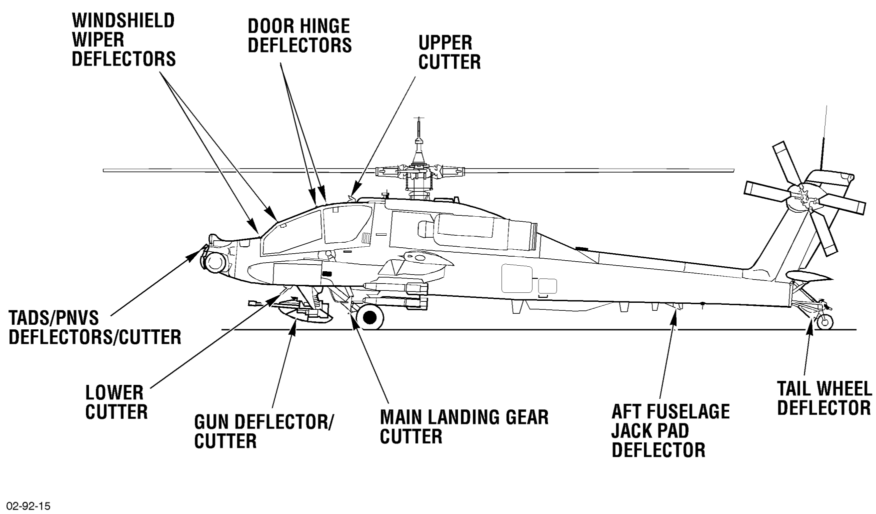
   c. Canopy door hinge deflectors (4)

   d. Upper cutter assembly

   e. Lower cutter assembly

   f. Gun deflector and cutter assembly

WIRE STRIKE PROTECTION SYSTEM (WSPS)



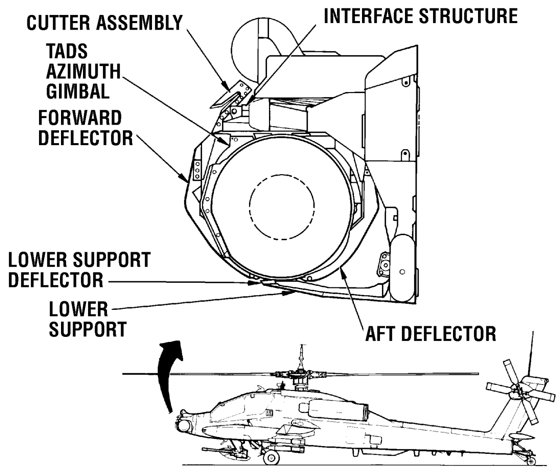
NOTES

g. Main landing gear cutter assembly (left and right)

h. Aft fuselage jack pad deflector

i. Tail wheel deflectors (3)

TADS/PNVS DEFLECTORS AND CUTTER ASSEMBLY



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NOTES

9. TADS/PNVS deflectors and cutter assembly

   a. The deflectors prevent wires and cables from snagging at the TADS assembly and help guide them either up to the PNVS cutter to be severed or down to the lower fuselage cutter to be severed.

   b. The PNVS cutter is designed to sever cables and wires and reduce the chance of snagging on the PNVS.

10. Two deflectors are attached to the TADS azimuth gimbal assembly, one to the forward side of the unit and one to the aft side.

11. A deflector is attached to the bottom of the TADS lower support assembly.

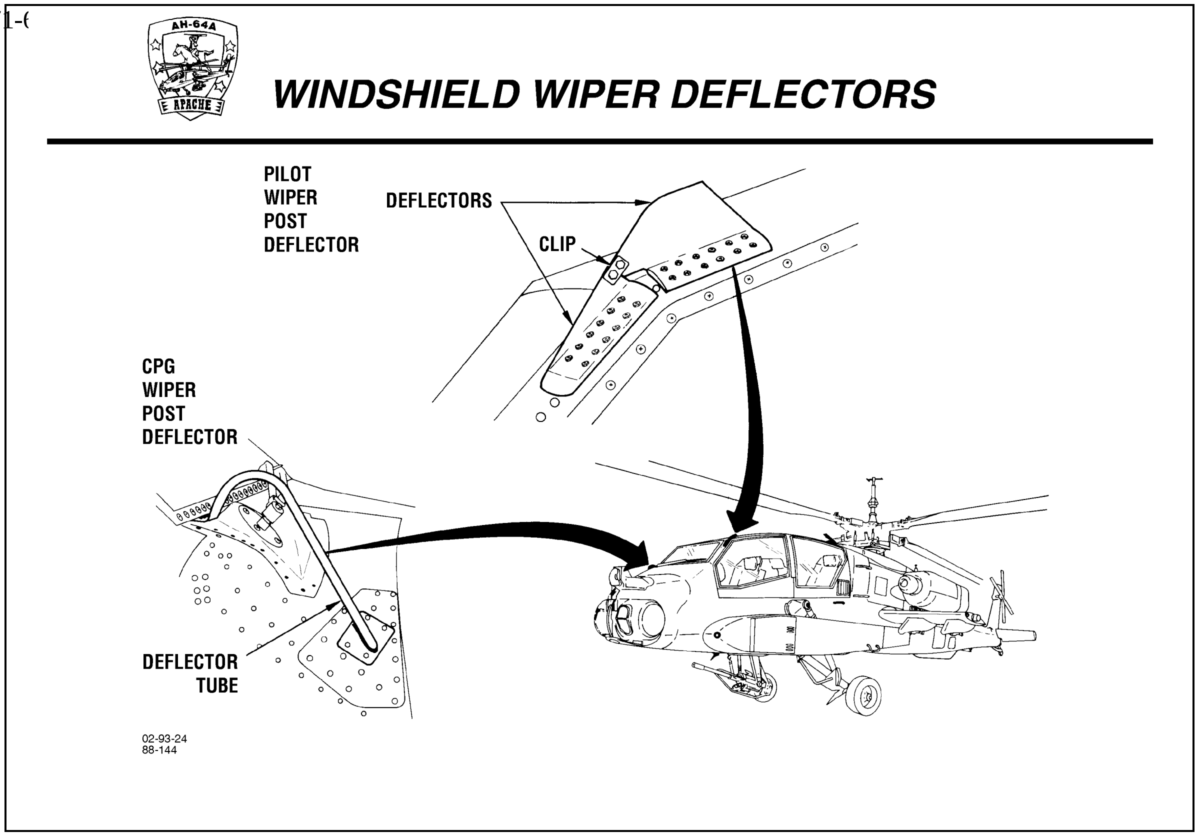
12. The cutter assembly is attached to the forward portion of the TADS/PNVS interface structure.

13. The forward and aft deflectors are constructed of aluminum alloy and are contoured to deflect impacting wires either upward or downward.

14. The two gimbal-installed deflectors provide protection when the TADS is stowed or in operation.

15. The lower support deflector is made of aluminum alloy. The forward portion is contoured to prevent impacting wires from snagging between the TADS azimuth gimbal and pivoting point at the lower support.

16. The cutter consists of two chromium molybdenum steel blades supported by a # 4130 heat-treated steel backing plate and deflector assembly. The thick, knife-edge blades converge to provide the means for severance.


AH-64A
APACHE
WINDSHIELD WIPER DEFLECTORS
PILOT
WIPER
POST
DEFLECTOR
DEFLECTORS
CLIP
CPG
WIPER
POST
DEFLECTOR
DEFLECTOR
TUBE
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88-144

NOTES

17. Windshield wiper deflectors (2)

    a. Prevent impacting wires from coming into contact with the pilot and CPG windshield wiper assemblies.

    b. Guide wires up over the windshield wiper assemblies to the upper fuselage cutter to be severed.

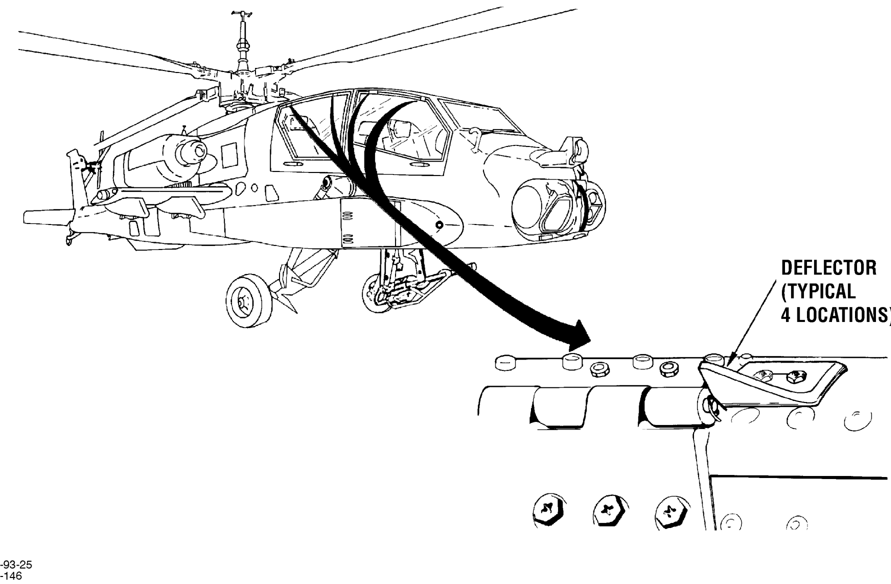
    c. The lower wiper post deflector is fastened to the right side of the helicopter forward fuselage, at the base of the CPG's windshield.

    d. The lower deflector consists of a steel tube welded to a steel support plate at one end, and a steel, angled bracket on the opposite end. The wall thickness of the tube is .065 inch.

    e. The upper wiper post deflector is fastened to the left side of the canopy support structure, adjacent to the pilot's windshield wiper.

    f. The upper deflector is a two-piece configuration. The steel deflectors are contoured to adapt to the side of canopy structure. Once mounted, the deflectors are joined together by two steel clips.

CANOPY DOOR HINGE DEFLECTORS



NOTES

18. Canopy door hinge deflectors (4)

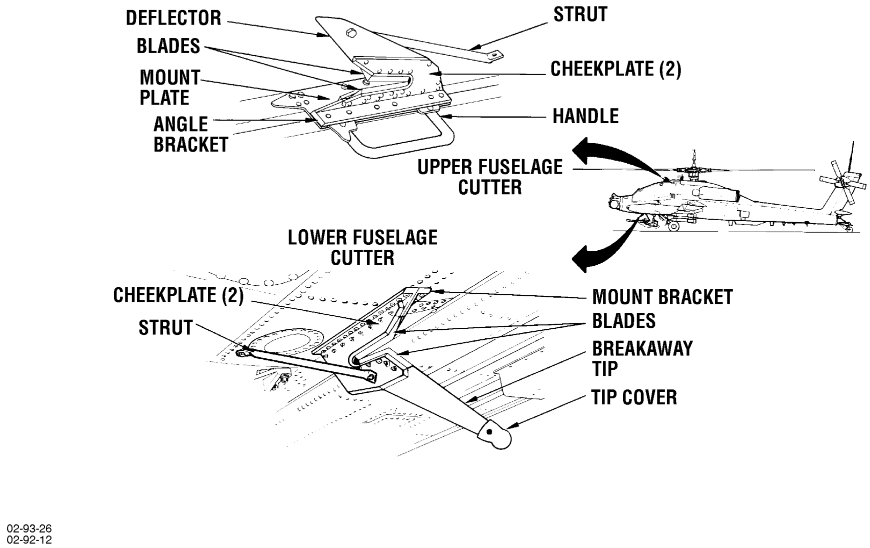
    a. Prevent impacting wires or cables from snagging at the four canopy door hinges.

    b. A deflector is fastened slightly forward of each door hinge at the upper right side of the canopy.

    c. Each deflector has a mounting surface and a raised, tapered edge.

    d. Design of deflectors permits access to hinge pin for unscheduled maintenance requirements.

UPPER AND LOWER FUSELAGE CUTTER ASSEMBLY



NOTES

19. Upper and lower fuselage cutter assemblies

a. Upper fuselage cutter assembly

(1) Severs wires or cables that impact along the upper fuselage structure.

(2) Attached to the handhold/mount plate at the left side of the upper aft canopy structure.

(3) Consists of two chromium molybdenum blade segments, sandwiched by two aluminum cheek plates.

(4) A steel deflector assembly is also sandwiched by the cheek plates, just above the upper blade.

(5) The cheek plates are attached to a steel angle bracket which is mounted to the handhold/mount plate.

(6) The cutter is stability-reinforced by a 12 inch x 10 inch steel strut assembly. The strut is bolted to the upper inboard side of the deflector at one end, and to a doubler fastened to the fuselage at the other end.

b. Lower cutter assembly

(1) Severs wires and cables that are deflected by the TADS, and impact along the bottom of the forward fuselage.

(2) Attached to a bracket assembly at the bottom of the forward fuselage, approximately 7.75 inches to the left of the fuselage center line.

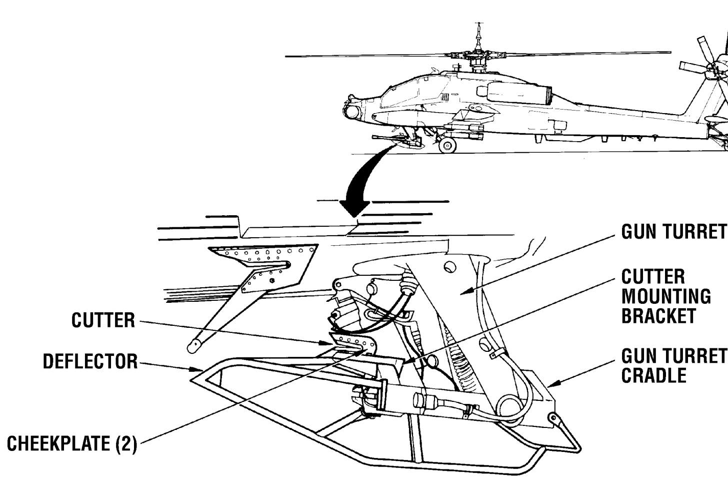
(3) Consist of three chromium molybdenum steel blade segments, sandwiched by two, aluminum cheek plates.

(4) The cutter is stability-reinforced by a 10.6 inch x 10 inch steel strut assembly. The strut is bolted to the upper inboard side of the cheek plate at one end and to a doubler fastened to the fuselage at the other end.

(5) A aluminum breakaway tip assembly extends downward, at an angle, from the cheek plate. A neoprene rubber tip cover is fastened to the end of the breakaway tip.

(6) The height of the cutter is restricted by the gun; therefore, maximum protection coverage is provided with the gun stowed.

GUN DEFLECTOR AND CUTTER ASSEMBLY



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NOTES

20. Gun deflector and cutter assembly

a. Designed to prevent wires or cables from snagging at the M230 gun.

b. Severs wires or cables that impact along the top portion of the gun barrel.

c. The deflector is attached to the gun turret cradle assembly at six different mount points.

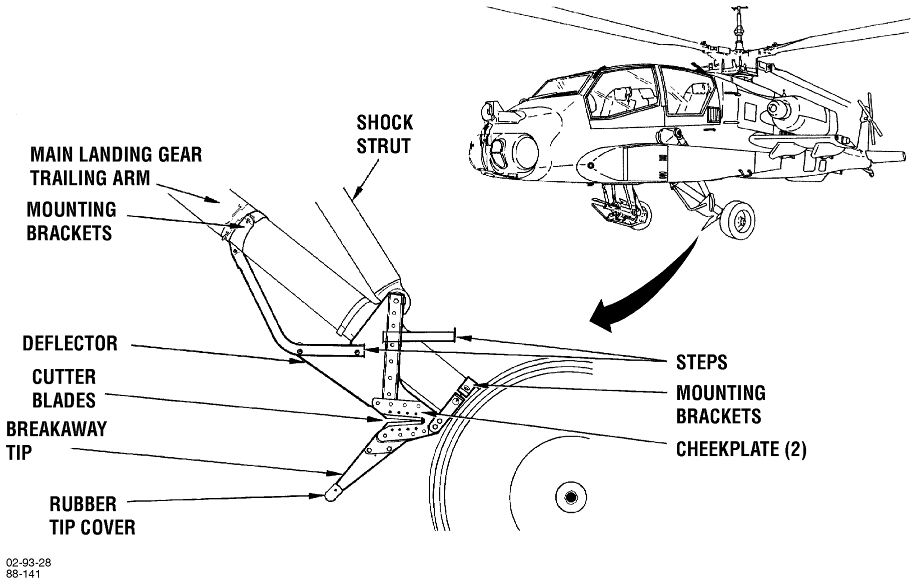
d. The cutter is attached to a mounting bracket at the upper center portion of the deflector.

e. The deflector is constructed of seven steel tube assemblies, welded together.

f. The cutter consists of two chromium molybdenum blade segments which are held in place by two aluminum cheek plates. The base of each cheek plate forms a 90E angle, to provide a mounting surface for the cutter.

g. Elevation and azimuth movement of the gun limits the protective capability of the deflector and cutter.

MAIN LANDING GEAR CUTTER ASSEMBLY



NOTES

21. Main landing gear cutter assembly (left and right)

    a. Designed to sever wires or cables impacting at the left and right main landing gear trailing arms.

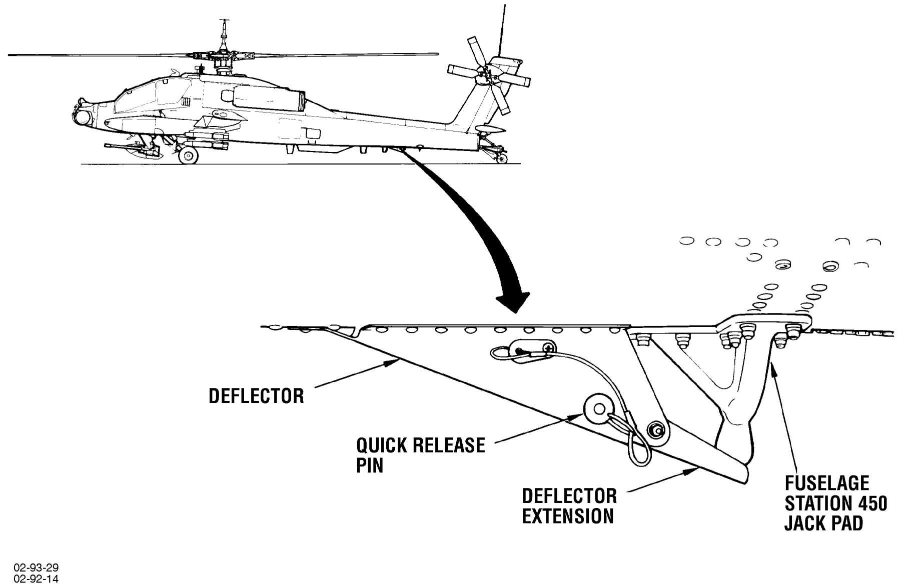
    b. Attached to the lower portion of the left and right main landing gear trailing arms.

    c. The cutter consists of two chromium molybdenum steel blade segments, which are attached to a deflector assembly by two aluminum cheek plates.

    d. The deflector is attached to the trailing arm, via the shock strut mounting hardware and two clamp assemblies. The deflector supports two steps that allow access to the crewstations and upper fuselage.

    e. An aluminum breakaway tip assembly extends downward, at an angle, from the deflector. A splice plate is riveted to the upper portion of the breakaway tip and provides interface to the deflector. A neoprene rubber tip cover is fastened to the end of the breakaway tip.

AFT FUSELAGE JACK PAD DEFLECTOR



NOTES

22. Aft fuselage jack pad deflector

    a. Prevents wires and cables from snagging at the aft fuselage jack pad.

    b. Attached to the lower portion of aft fuselage, just forward of fuselage station 450 jack pad.

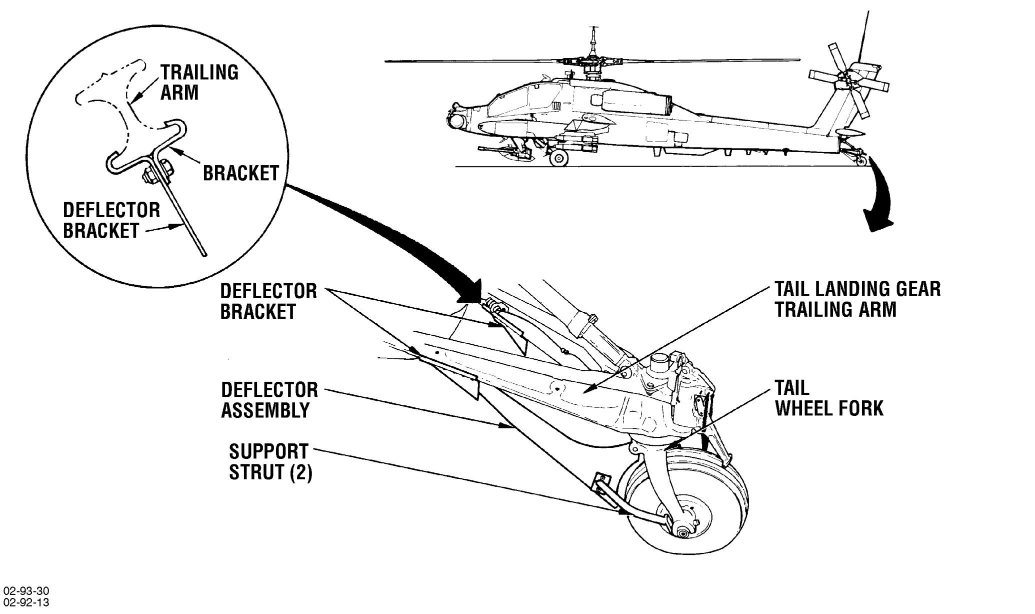
    c. The angled deflector is fastened to the airframe just forward of F.S. 450 jack pad, and a deflector extension is bolted to it.

    d. The deflectors are constructed of aluminum alloy.

    e. The deflector has a corrosion-resistant steel lanyard attached to the left side. A quick-release pin is attached to the opposite end and secures the deflector extension in the deflector mode.

    f. To facilitate jacking, the quick-release pin is removed and the deflector extension is allowed to pivot out of the way.

TAIL WHEEL DEFLECTORS



NOTES

23. Tail wheel deflectors

a. Prevent wires or cables from snagging at the TLG trailing arm and wheel/fork assembly.

b. Two small deflectors are attached to the forward portion of the TLG trailing arm.

c. A large deflector is attached to the tail wheel fork.

d. A single, two-piece steel deflector is fastened to the left and right side of the I-beam trailing arm.

e. Two, steel tubular struts and an attachment point at the base of the tail wheel fork support the aluminum alloy deflector at the tail wheel.

AH-64A AIRFRAME MATERIALS

MATERIALS	APPLICATIONS	QUALITIES
Aluminum	(1) Fuselage skin (2) Fuselage stringers (3) Bulkheads (4) Nacelle inlets	(1) The skin is ALCLAD, which provides resistance to corrosion (2) Good strength to weight ratio (3) Easily alloyed with other materials to enhance it's metallurgical structure
Composite Materials (A) Carbon/Graphite (B) Kevlar	(1) Fairings (2) Stabilator tips (3) Bulkheads (4) Tailcone (5) Armor (6) Duct work (7) Glare shield (8) Airframe insulation (9) Airframe shielding	(1) Superior strength vs weight ratio (2) Carbon offers long service life, a high ability to transfer aerodynamic loads (3) Higher strength-to-weight ratio (4) Kevlar offers high impact resistance and low radio frequency attenuation
Titanium	(1) Airframe fasteners	(1) High strength to weight ratio compared to steel (2) High corrosion resistance

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NOTES

A. AH-64A airframe materials

1. Aluminum alloys

a. Are used primarily in the construction of

(1) Fuselage skin

(2) Fuselage stringers

(3) Bulkheads

(4) Nacelle inlets

b. Majority of the aluminum alloy skin is flat-wrapped for ease of repair. The skin is ALCLAD, which provides resistance to corrosion.

c. Commercially-pure aluminum does not possess the properties required for aerospace application, so it must be alloyed with other materials to enhance it's metallurgical structure.

d. Aluminum alloys have one inherent drawback as a structural material, they are susceptible to corrosion. Their good strength-to-weight ratio has caused metallurgists to devise ways of overcoming this problem, and today aluminum alloys are the most important metal used for aircraft construction.

e. Alloying agents and designations - the first major breakthrough in the use of aluminum as a structural material came when it was alloyed with copper, with the addition of a small amount of magnesium and manganese. This was done by the Germans who called the alloy "Duralumin," which is the origin of the contraction that is often used, "dural".

f. A numbering system is used to describe the alloying elements. For aluminum alloys we use a four-digit system in which the first digit denotes the primary alloying element and the other digits identify the specific alloy.

Alloy No. Series	Chief Alloying Element
1XXX	99% Aluminum, minimum
2XXX	Copper
3XXX	Manganese
4XXX	Silicon
5XXX	Magnesium
6XXX	Magnesium and silicon
7XXX	Zinc
8XXX	Other Elements

AH-64A AIRFRAME MATERIALS

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NOTES

g. Commercially pure aluminum is identified as 1100 and is seldom used in aircraft construction. Alloy 3003, which is almost the same, but has just a small amount of manganese in it, is used for cowling and for other non-loadbearing applications. Alloy 2017 contains copper, manganese, and magnesium and has been superseded by alloy 2024, which has the same alloying elements but in slightly different proportions. Alloy 2024 is used for most modern structures. Zinc increases the strength of aluminum, and alloy 7075 is used for many high-strength applications.

h. The following is a list of aluminum alloy applications for the AH-64A airframe

(1) Alloy 2024 is used for aircraft skins, frames, and engine cooling system.

(2) Alloy 7049 is used for stringers and machined frames.

(3) Alloy 6061 used in nacelle inlets and other welded components.

2. Composite materials

a. The AH-64A is made up of numerous composite structures including

(1) Fairings

(2) Stabilator tips

(3) Bulkheads

(4) Tailcone

(5) Armor

(6) Duct work

(7) Glare shield

(8) Airframe insulation

(9) Airframe shielding

b. Composite materials applicable to aerospace construction are made by embedding high-strength, high-modulus fibers within an essentially homogeneous resin matrix. The fibers are typically fiberglass, kevlar, and carbon. The thermoset resin matrixes are typically epoxy, polyimide, polyester, and phenolic.

AH-64A AIRFRAME MATERIALS

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NOTES

c. Carbon/graphite

(1) Carbon/graphite is used for primary structures because of it's superior strength-to-weight ratio.

(2) Typical weight savings of 20% to 25% can be obtained through the application of composite materials over conventional construction techniques. Additionally, carbon offers long service life, and high ability to transfer aerodynamic loads.

(3) Carbon fibers are produced by the pyrolysis of organic precursor fibers such as rayon, polyacrylonitrile, and pitch in an inert environment. The term is often used interchangeably with the term graphite; however, carbon fibers and graphite fibers differ. The basic differences lie in the temperature at which the fibers are made and heat treated, and in the amount of elemental carbon produced.

(a) Carbon fibers typically are carbonized in the region of 2400E F (1315E C) and assay 93% to 95% carbon.

(b) Graphite fibers are graphitized at 3450E F to 4500E F (1900E C to 2480E C) and assay at more than 99% elemental carbon.

(4) Carbon cannot be placed in intimate contact with aluminum structures without a barrier material being applied (typically a layer of E or S fiberglass, because of corrosion). Titanium, however, does not require a barrier because of its metallurgical structure.

(5) It should be noted that significant health risks exist for maintenance personnel improperly exposed to certain chemicals and compounds. All notices and warnings must be strictly adhered to when working with any composite material.

(6) Composites in general have many advantages over conventional structures, some include: weight savings of 20% to 25%, improved performance, larger payloads possible, fewer mechanical fasteners required, longer service life, increased durability, and lower thermal expansion.

d. Kevlar

(1) Kevlar is used for fabrication of most secondary structures and duct-work because of its higher strength-to-weight ratio.

(2) Kevlar, a strong organic fiber, yellow in color, similar to fiberglass but having a higher strength-to-weight ratio. For use on aircraft, Kevlar is woven into a cloth and impregnated with a thermosetting resin. It then produces a material having high-impact resistance and low radio frequency attenuation.

AH-64A AIRFRAME MATERIALS

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NOTES

(3) Kevlar is extremely hydroscopic and will readily absorb moisture if left unsealed.

(4) When drilling Kevlar, it is recommended that a parabolic-type drill be used and always use backing to prevent fiber breakout/blowout.

3. Titanium

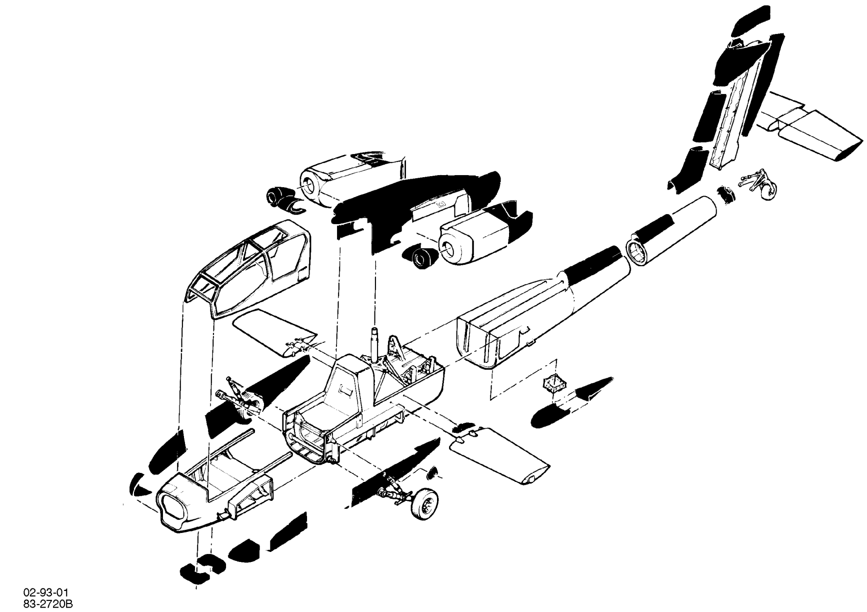
a. The use of titanium for building aircraft has steady increased over the past two decades. The most popular form of titanium alloy used in the aerospace industry is 6AL-4V. The 6AL means 6% aluminum alloy, the 4V means 4% vanadium, and the remaining 90% is titanium.

(1) High strength-to-weight ratio, compared to steel.

(2) High corrosion resistance.

b. In the AH-64A, titanium is used for many airframe fasteners, the aft inboard mount point, and the stringer of the engine nacelles.

KEVLAR PANEL LOCATION



NOTES

4. Kevlar panels

   a. Provides environmental protection for the helicopter systems and components.

   b. Improves aerodynamic efficiency.

   c. Establish an electromagnetic interference (EMI) boundary for aircraft with operational back-up control systems (A/C S/Ns 88-0200 and subsequent).

   d. Kevlar provides a number of advantageous properties for aircraft applications.

      (1) Weight - most advantageous property.

      (2) Strength - has a very high specific strength for a commercially available material.

      (3) Ballistic impact - equivalent ballistic protection can be obtained at a substantial reduction in weight, or improved resistance can be achieved at equal weight when compared to fiberglass.

      (4) Flammability - meets all the flammability and smoke requirements for aircraft interior and exterior uses with a performance exceeding the minimum approved by the Army.

   e. Types of Kevlar panels

      (1) Kevlar/epoxy skin

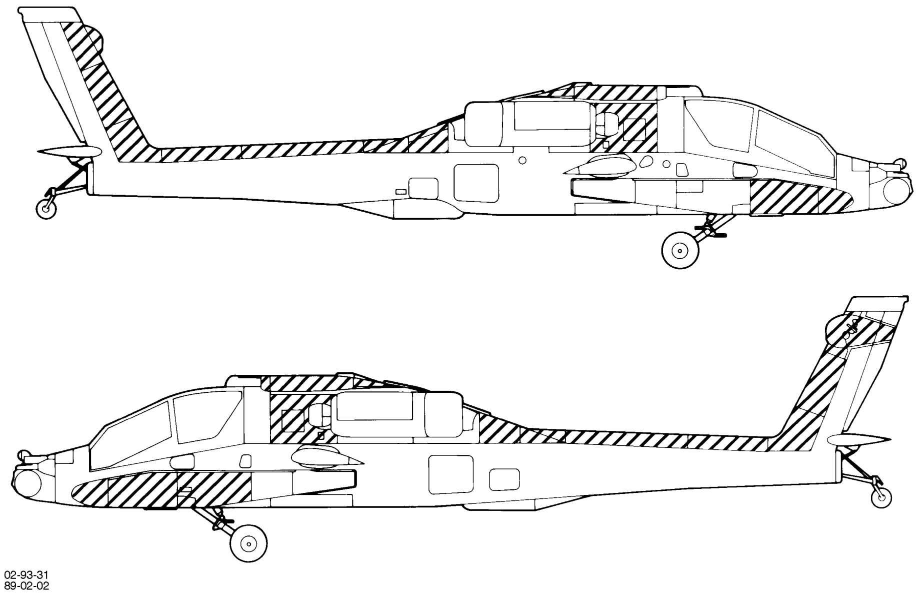
      (2) Kevlar/epoxy fairing

      (3) Kevlar/epoxy bonded honeycomb

   f. FABs, turret, ammunition feed mechanisms (FAB extensions), MLG shock strut fittings, wing attachment points (upper and lower), engine nose gearboxes, No. 1 and No. 2 drive shafts, left and right transmission access, upper transmission and main rotor drive shaft areas, aft equipment bay access, hydraulic ground service equipment access, number 4, 5, and 6 drive shafts, aft engine nacelles, doppler, aft fuselage/tailboom cover, tailboom closeout, vertical stabilizer leading edge, trailing edge, tip, stabilator tip caps, and the intermediate and tail rotor gearboxes are all covered with Kevlar panels.

   g. Inspect Kevlar panels in accordance with TM 55-1520-238-23-2.

AH-64A FAIRINGS WITH CONDUCTIVE PAINT A/C S/N 88-0200 AND SUBS.



NOTES

5. Fairings with conductive paint

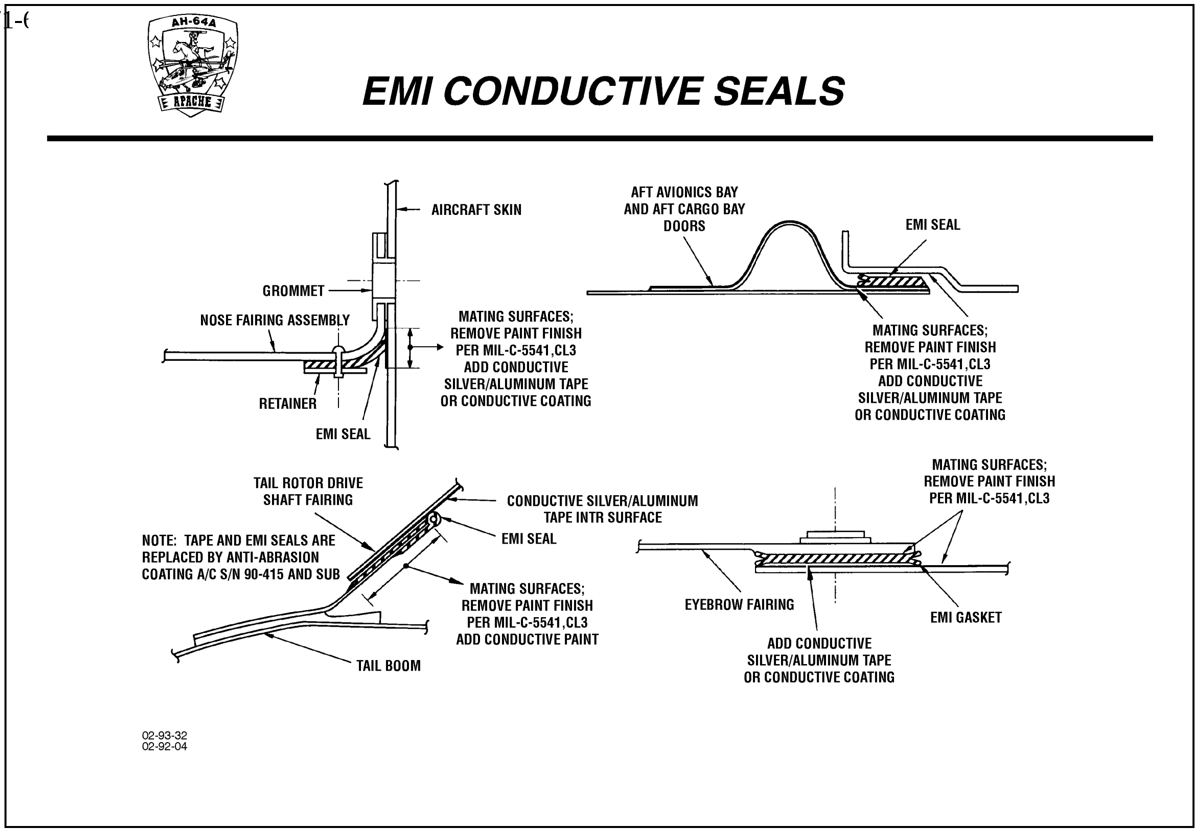
    a. Modified Kevlar fairings

    b. Specific Kevlar components are coated on their inner sides with a conductive shield material (silver paint), which provides an airframe ground path for EMI. This helps to protect the digital automatic stabilization equipment computer's electrical signals during operation of the backup control systems (BUCS).

6. To provide an EMI conductive surface from the aircraft skin to the conductive Kevlar fairings and to certain aluminum panels and doors, conductive seals and/or silver/aluminum tape is installed on their mating surfaces. Thus an EMI boundary is established for the BUCS system.

7. Black silver oxide is a natural phenomenon with silver pigment conductive paint. Since the silver oxide is highly conductive, it is still functional and removal is not necessary.

8. Contaminants on or near edges, such as fuel, oils, and dirt, must be cleaned to prevent coating of gaskets, tape, and loosening of adhesives.


AH-64A
APACHE
EMI CONDUCTIVE SEALS
AIRCRAFT SKIN
GROMMET
NOSE FAIRING ASSEMBLY
MATING SURFACES; REMOVE PAINT FINISH PER MIL-C-5541,CL3 ADD CONDUCTIVE SILVER/ALUMINUM TAPE OR CONDUCTIVE COATING
RETAINER
EMI SEAL
AFT AVIONICS BAY AND AFT CARGO BAY DOORS
EMI SEAL
MATING SURFACES; REMOVE PAINT FINISH PER MIL-C-5541,CL3 ADD CONDUCTIVE SILVER/ALUMINUM TAPE OR CONDUCTIVE COATING
TAIL ROTOR DRIVE SHAFT FAIRING
CONDUCTIVE SILVER/ALUMINUM TAPE INTR SURFACE
EMI SEAL
NOTE: TAPE AND EMI SEALS ARE REPLACED BY ANTI-ABRASION COATING A/C S/N 90-415 AND SUB
MATING SURFACES; REMOVE PAINT FINISH PER MIL-C-5541,CL3 ADD CONDUCTIVE PAINT
TAIL BOOM
MATING SURFACES; REMOVE PAINT FINISH PER MIL-C-5541,CL3
EYEBROW FAIRING
EMI GASKET
ADD CONDUCTIVE SILVER/ALUMINUM TAPE OR CONDUCTIVE COATING
02-93-32
02-92-04

NOTES

9. EMI conductive seals

   a. A "single lip" EMI seal, retained by a metal retainer, mates with the silver/aluminum tape in these applied areas.

      (1) L60 and R60, FAB nose fairing assemblies. Seal is on the fairing and tape on the aircraft skin.

      (2) L90 and R90, FAB access doors. Seal is on the airframe (except where latches contact) and the tape is on the doors.

      (3) T250L and T250R, T290L and T290R aft equipment bay doors. Seals on the left doors and the tape on the right doors.

   b. An EMI seal with a "double lip" is bonded to the aluminum door surface and mates with the tape on the aircraft skin in these applications

      (1) L295, aft cargo stowage door

      (2) R295, aft avionics bay door

   c. A "rolled" EMI seal is bonded to the airframe flange along the tailboom and mates with the tape on the following fairings

      (1) R410, No. 4 tail rotor drive shaft fairing

      (2) R475, No. 5 tail rotor drive shaft fairing

   d. An EMI seal with two "double lips" is bonded to the aluminum panel surface and forms a gasket against the silver/aluminum tape on these fairings

      (1) L40, "Eyebrow" electronic equipment cover

      (2) R40, "Eyebrow" electronic equipment cover

10. Several other fairings use silver/aluminum tape on both mating surfaces without the need for any of the seals.

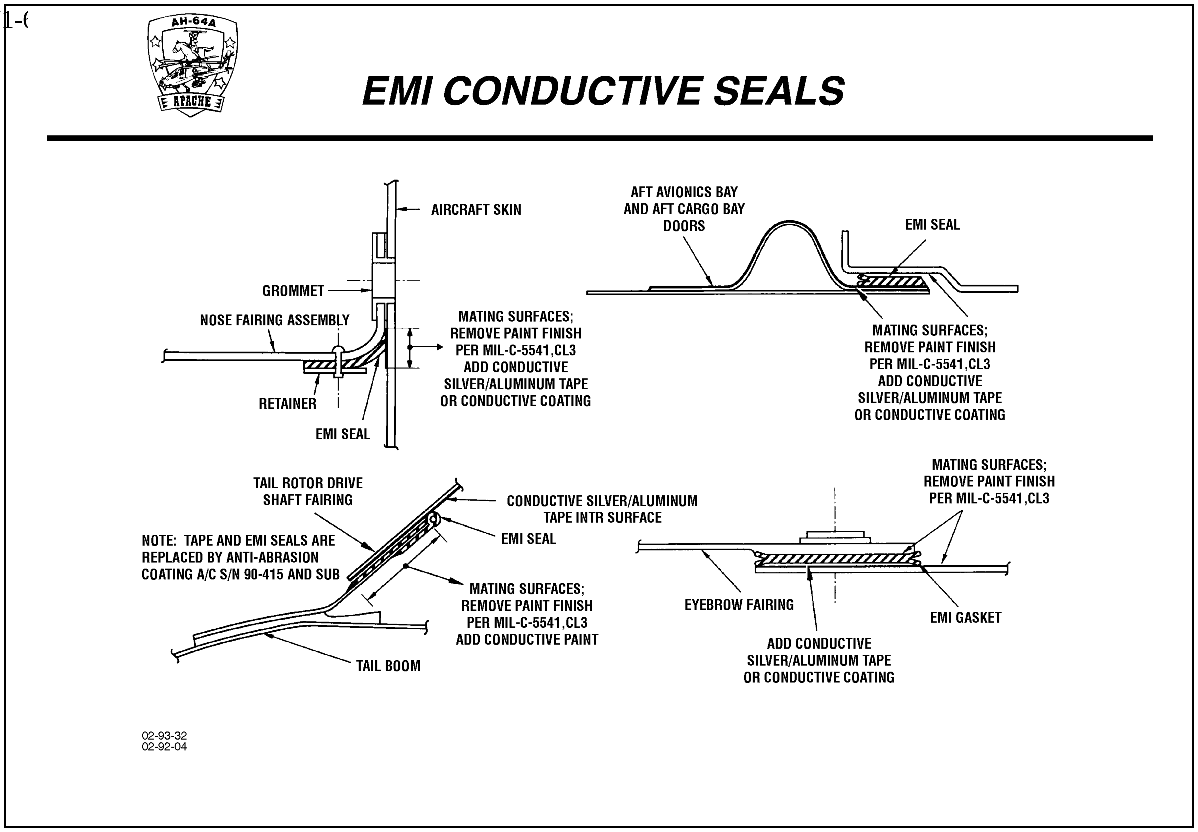
   a. L540, tail rotor transmission fairing

   b. L510, vertical stabilizer fairing

   c. L530, vertical stabilizer leading edge fairing

   d. L200 and R200, main rotor transmission access panels

   e. T355, forward tail rotor driveshaft fairing



AH-64A
APACHE
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02-93-32
02-92-04

NOTES

- f. L140 and L175, ammunition feed mechanism fairings
- g. R325, ground support equipment (GSE) access door
- h. L325, catwalk access door

11. EMI tape

    - a. The aluminum tape used as the faying surface for EMI gaskets must be bubble free and with minimum wrinkles, not to exceed two cross bands in a six inch section.
    - b. The paint over spray of aluminum tape must not cover the joining surface of the gasket or opposite tape surfaces in such installations. In no case shall spray exceed 50% of tape width.
    - c. Torn tape around fasteners is allowable if the gap is limited to one side of the fastener and not wider than 0.25 inches.
    - d. Torn tape that has adequate conductive adhesive may be re-attached if the resulting gap is less than 0.25 inches.
    - e. Contaminants on tape shall be removed with a soft cloth and isopropyl alcohol taking care not to loosen adhesive or damage coating on the tape.
    - f. Black residue on tape caused by either aluminum flaking (abrasion) or silver oxide will not degrade shields if less than 20% of periphery.
    - g. Aluminum oxide (white residue) must be removed and tape refinished or replaced as appropriate.

12. EMI gaskets

    - a. Adhesive used for EMI gasket attachment must not exceed 0.010 inches in thickness as conductivity degrades with thickness.
    - b. Gaps between gasket and faying surfaces are not allowed on forward and aft avionics bays. Other components such as the drive shaft covers, vertical stabilizer, and intermediate gearbox fairings may have gaps not longer than six inches nor more than 0.050 inches between surfaces.
    - c. Torn gaskets may be reinstalled if adhesive will maintain the gasket in position and the spaces across the torn area (butt joint) does not exceed 0.030 inches.

13. Inspection of the EMI seals and silver/aluminum tape in accordance with TM 55-1520-238-23-2.

14. Repair procedures for the EMI seals and silver/aluminum tape will be in accordance with TM 55-1520-238-23-2 Chapter 2, paragraphs 2-3-110 and 2-3-111.